Framework for Improving
Critical Infrastructure Cybersecurity

Draft Version 1.1

National Institute of Standards and Technology

January 10, 2017

Note to Reviewers on the Update and Next Steps

The draft Version 1.1 of Cybersecurity Framework refines, clarifies, and enhances the predecessor version 1.0

Version 1.1 can be implemented by first time and current Framework users. Current users can implement Version 1.1 with minimal or no disruption, as refinements were made with the objective of being compatible with Version 1.0.

As with Version 1.0, use of the Version 1.1 is voluntary. Users of Version 1.1 are invited to customize the Framework to maximize organizational value.

The impetus to change and the proposed changes were collected from:

- Feedback and frequently asked questions to NIST since release of Framework Version 1.0 in February 2014,
- 105 responses to the December 2015 request for information (RFI), *Views on the Framework for Improving Critical Infrastructure Cybersecurity*, and
- Comments provided by approximately 800 attendees at a workshop held in Gaithersburg, Maryland on April 6-7, 2016.

In addition, NIST previously released Version 1.0 of the Cybersecurity Framework with a companion document, *NIST Roadmap for Improving Critical Infrastructure Cybersecurity*. This Roadmap highlighted key "areas of improvement" for further "development, alignment, and collaboration." Through both private and public sector efforts, some areas of improvement have advanced enough to be included in the Framework Version 1.1.

Key refinements, clarifications, and enhancements in Framework Version 1.1 include:

Update	Description of Update
A new section on cybersecurity measurement	Added Section 4.0 Measuring and Demonstrating Cybersecurity to discuss correlation of business results to cybersecurity risk management metrics and measures.
Greatly expanded explanation of using Framework for Cyber Supply Chain Risk Management purposes	Considerations of Cyber Supply Chain Risk Management (SCRM) have been added throughout the document. An expanded Section 3.3 Communicating Cybersecurity Requirements with Stakeholders help users better understand Cyber SCRM. Cyber SCRM has also been added as a property of Implementation Tiers. Finally, a Supply Chain Risk Management Category has been added to the Framework Core.
Refinements to better account for authentication, authorization, and identity proofing	The language of the Access Control Category has been refined to account for authentication, authorization, and identity proofing. A Subcategory has been added to that Category. Finally, the Category has been renamed to Identity Management and Access Control (PR.AC) to better represent the scope of the Category and corresponding Subcategories.
Better explanation of the relationship between Implementation Tiers and Profiles	Added language to Section 3.2 Establishing or Improving a Cybersecurity Program on using Framework Tiers in Framework implementation. Added language to Framework Tiers to reflect integration of Framework considerations within organizational risk management programs. Updated Figure 2.0 to include actions from the Framework Tiers.

22   A more detailed review of Version 1.1 refinements, clarifications, and enhancements can be
23   found in Appendix D.

24   NIST is seeking public comment on this draft Framework Version 1.1, specifically regarding the
25   following questions:

26   •   Are there any topics not addressed in the draft Framework Version 1.1 that could be
27   addressed in the final?
28   •   How do the changes made in the draft Version 1.1 impact the cybersecurity ecosystem?
29   •   For those using Version 1.0, would the proposed changes impact your current use of the
30   Framework? If so, how?
31   •   For those not currently using Version 1.0, does the draft Version 1.1 affect your decision
32   to use the Framework? If so, how?
33   •   Does this proposed update adequately reflect advances made in the Roadmap areas?
34   •   Is there a better label than "version 1.1" for this update?
35   •   Based on this update, activities in Roadmap areas, and activities in the cybersecurity
36   ecosystem, are there additional areas that should be added to the Roadmap? Are there
37   any areas that should be removed from the Roadmap?

38   Feedback and comments should be directed to cyberframework@nist.gov. After reviewing
39   public comments regarding the draft Version 1.1 and convening a workshop on the Framework,
40   NIST intends to publish a final Framework Version 1.1 around the fall of 2017.
41

Table of Contents

List of Figures

List of Tables

61   ## Executive Summary

62   The national and economic security of the United States depends on the reliable functioning of
63   critical infrastructure. Cybersecurity threats exploit the increased complexity and connectivity of
64   critical infrastructure systems, placing the Nation's security, economy, and public safety and
65   health at risk. Similar to financial and reputational risk, cybersecurity risk affects a company's
66   bottom line. It can drive up costs and impact revenue. It can harm an organization's ability to
67   innovate and to gain and maintain customers.

68   To better address these risks, the President issued Executive Order 13636, "Improving Critical
69   Infrastructure Cybersecurity," on February 12, 2013, which established that "[i]t is the Policy of
70   the United States to enhance the security and resilience of the Nation's critical infrastructure and
71   to maintain a cyber environment that encourages efficiency, innovation, and economic prosperity
72   while promoting safety, security, business confidentiality, privacy, and civil liberties." In
73   enacting this policy, the Executive Order calls for the development of a voluntary risk-based
74   Cybersecurity Framework – a set of industry standards and best practices to help organizations
75   manage cybersecurity risks. The resulting Framework, created through collaboration between
76   government and the private sector, uses a common language to address and manage
77   cybersecurity risk in a cost-effective way based on business needs without placing additional
78   regulatory requirements on businesses.

79   The Framework focuses on using business drivers to guide cybersecurity activities and
80   considering cybersecurity risks as part of the organization's risk management processes. The
81   Framework consists of three parts: the Framework Core, the Framework Profile, and the
82   Framework Implementation Tiers. The Framework Core is a set of cybersecurity activities,
83   outcomes, and informative references that are common across critical infrastructure sectors,
84   providing the detailed guidance for developing individual organizational Profiles. Through use of
85   the Profiles, the Framework will help the organization align its cybersecurity activities with its
86   business requirements, risk tolerances, and resources. The Tiers provide a mechanism for
87   organizations to view and understand the characteristics of their approach to managing
88   cybersecurity risk.

89   The Executive Order also requires that the Framework include a methodology to protect
90   individual privacy and civil liberties when critical infrastructure organizations conduct
91   cybersecurity activities. While processes and existing needs will differ, the Framework can assist
92   organizations in incorporating privacy and civil liberties as part of a comprehensive
93   cybersecurity program.

94   The Framework enables organizations – regardless of size, degree of cybersecurity risk, or
95   cybersecurity sophistication – to apply the principles and best practices of risk management to
96   improving the security and resilience of critical infrastructure. The Framework provides
97   organization and structure to today's multiple approaches to cybersecurity by assembling
98   standards, guidelines, and practices that are working effectively in industry today. Moreover,
99   because it references globally recognized standards for cybersecurity, the Framework can also be
100   used by organizations located outside the United States and can serve as a model for
101   international cooperation on strengthening critical infrastructure cybersecurity.

102 The Framework is not a one-size-fits-all approach to managing cybersecurity risk for critical
103 infrastructure. Organizations will continue to have unique risks – different threats, different
104 vulnerabilities, different risk tolerances – and how they implement the practices in the
105 Framework will vary. Organizations can determine activities that are important to critical service
106 delivery and can prioritize investments to maximize the impact of each dollar spent. Ultimately,
107 the Framework is aimed at reducing and better managing cybersecurity risks.

108 The Framework is a living document and will continue to be updated and improved as industry
109 provides feedback on implementation. NIST will continue coordinating industry as directed in
110 the Cybersecurity Enhancement Act of 2014[1]. As the Framework is put into practice, lessons
111 learned will be integrated into future versions. This will ensure it is meeting the needs of critical
112 infrastructure owners and operators in a dynamic and challenging environment of new threats,
113 risks, and solutions.

114 Use, evolution, and sharing of best practices of this voluntary Framework is are the next steps to
115 improve the cybersecurity of our Nation's critical infrastructure – providing guidance for
116 individual organizations, while increasing the cybersecurity posture of the Nation's critical
117 infrastructure as a whole.

---

[1] *See* 15 U.S.C. § 272(e)(1)(A)(i). The Cybersecurity Enhancement Act of 2014 (S.1353) became public law 113-274 on December 18, 2014 and may be found at: https://www.congress.gov/bill/113th-congress/senate-bill/1353/text.

1.0 Framework Introduction

The national and economic security of the United States depends on the reliable functioning of critical infrastructure. To strengthen the resilience of this infrastructure, President Obama issued Executive Order 13636 (EO), "Improving Critical Infrastructure Cybersecurity," on February 12, 2013.[2] This Executive Order calls for the development of a voluntary Cybersecurity Framework ("Framework") that provides a "prioritized, flexible, repeatable, performance-based, and cost-effective approach" to manage cybersecurity risk for those processes, information, and systems directly involved in the delivery of critical infrastructure services. The Framework, developed in collaboration with industry, provides guidance to an organization on managing cybersecurity risk.

Critical infrastructure is defined in the EO as "systems and assets, whether physical or virtual, so vital to the United States that the incapacity or destruction of such systems and assets would have a debilitating impact on security, national economic security, national public health or safety, or any combination of those matters." Due to the increasing pressures from external and internal threats, organizations responsible for critical infrastructure need to have a consistent and iterative approach to identifying, assessing, and managing cybersecurity risk. This approach is necessary regardless of an organization's size, threat exposure, or cybersecurity sophistication today.

The critical infrastructure community includes public and private owners and operators, and other entities with a role in securing the Nation's infrastructure. Members of each critical infrastructure sector perform functions that are supported by information technology (IT) and industrial control systems (ICS).[3] This reliance on technology, communication, and the interconnectivity of IT and ICS has changed and expanded the potential vulnerabilities and increased potential risk to operations. For example, as ICS and the data produced in ICS operations are increasingly used to deliver critical services and support business decisions, the potential impacts of a cybersecurity incident on an organization's business, assets, health and safety of individuals, and the environment should be considered. To manage cybersecurity risks, a clear understanding of the organization's business drivers and security considerations specific to its use of IT and ICS is required. Because each organization's risk is unique, along with its use of IT and ICS, the tools and methods used to achieve the outcomes described by the Framework will vary.

Recognizing the role that the protection of privacy and civil liberties plays in creating greater public trust, the Executive Order requires that the Framework include a methodology to protect individual privacy and civil liberties when critical infrastructure organizations conduct cybersecurity activities. Many organizations already have processes for addressing privacy and civil liberties. The methodology is designed to complement such processes and provide guidance to facilitate privacy risk management consistent with an organization's approach to cybersecurity risk management. Integrating privacy and cybersecurity can benefit organizations by increasing customer confidence, enabling more standardized sharing of information, and simplifying operations across legal regimes.

---

[2] Executive Order no. 13636, *Improving Critical Infrastructure Cybersecurity*, DCPD-201300091, February 12, 2013. https://www.gpo.gov/fdsys/pkg/CFR-2014-title3-vol1/pdf/CFR-2014-title3-vol1-eo13636.pdf

[3] The DHS Critical Infrastructure program provides a listing of the sectors and their associated critical functions and value chains. http://www.dhs.gov/critical-infrastructure-sectors

157   To ensure extensibility and enable technical innovation, the Framework is technology neutral.
158   The Framework relies on a variety of existing standards, guidelines, and practices to enable
159   critical infrastructure providers to achieve resilience. By relying on those global standards,
160   guidelines, and practices developed, managed, and updated by industry, the tools and methods
161   available to achieve the Framework outcomes will scale across borders, acknowledge the global
162   nature of cybersecurity risks, and evolve with technological advances and business requirements.
163   The use of existing and emerging standards will enable economies of scale and drive the
164   development of effective products, services, and practices that meet identified market needs.
165   Market competition also promotes faster diffusion of these technologies and practices and
166   realization of many benefits by the stakeholders in these sectors.

167   Building from those standards, guidelines, and practices, the Framework provides a common
168   taxonomy and mechanism for organizations to:

169   1) Describe their current cybersecurity posture;

170   2) Describe their target state for cybersecurity;

171   3) Identify and prioritize opportunities for improvement within the context of a
172   continuous and repeatable process;

173   4) Assess progress toward the target state;

174   5) Communicate among internal and external stakeholders about cybersecurity risk.

175   The Framework complements, and does not replace, an organization's risk management process
176   and cybersecurity program. The organization can use its current processes and leverage the
177   Framework to identify opportunities to strengthen and communicate its management of
178   cybersecurity risk while aligning with industry practices. Alternatively, an organization without
179   an existing cybersecurity program can use the Framework as a reference to establish one.

180   Just as the Framework is not industry-specific, the common taxonomy of standards, guidelines,
181   and practices that it provides also is not country-specific. Organizations outside the United States
182   may also use the Framework to strengthen their own cybersecurity efforts, and the Framework
183   can contribute to developing a common language for international cooperation on critical
184   infrastructure cybersecurity.

1.1   Overview of the Framework

186   The Framework is a risk-based approach to managing cybersecurity risk, and is composed of
187   three parts: the Framework Core, the Framework Implementation Tiers, and the Framework
188   Profiles. Each Framework component reinforces the connection between business drivers and
189   cybersecurity activities. These components are explained below.

190   •   The *Framework Core* is a set of cybersecurity activities, desired outcomes, and
191   applicable references that are common across critical infrastructure sectors. The Core
192   presents industry standards, guidelines, and practices in a manner that allows for
193   communication of cybersecurity activities and outcomes across the organization from the
194   executive level to the implementation/operations level. The Framework Core consists of
195   five concurrent and continuous Functions—Identify, Protect, Detect, Respond, Recover.
196   When considered together, these Functions provide a high-level, strategic view of the
197   lifecycle of an organization's management of cybersecurity risk. The Framework Core

198 then identifies underlying key Categories and Subcategories for each Function, and
199 matches them with example Informative References such as existing standards,
200 guidelines, and practices for each Subcategory.

201 • *Framework Implementation Tiers* ("Tiers") provide context on how an organization
202   views cybersecurity risk and the processes in place to manage that risk. Tiers describe the
203   degree to which an organization's cybersecurity risk management practices exhibit the
204   characteristics defined in the Framework (e.g., risk and threat aware, repeatable, and
205   adaptive). The Tiers characterize an organization's practices over a range, from Partial
206   (Tier 1) to Adaptive (Tier 4). These Tiers reflect a progression from informal, reactive
207   responses to approaches that are agile and risk-informed. During the Tier selection
208   process, an organization should consider its current risk management practices, threat
209   environment, legal and regulatory requirements, business/mission objectives, and
210   organizational constraints.

211 • A *Framework Profile* ("Profile") represents the outcomes based on business needs that an
212   organization has selected from the Framework Categories and Subcategories. The Profile
213   can be characterized as the alignment of standards, guidelines, and practices to the
214   Framework Core in a particular implementation scenario. Profiles can be used to identify
215   opportunities for improving cybersecurity posture by comparing a "Current" Profile (the
216   "as is" state) with a "Target" Profile (the "to be" state). To develop a Profile, an
217   organization can review all of the Categories and Subcategories and, based on business
218   drivers and a risk assessment, determine which are most important; they can add
219   Categories and Subcategories as needed to address the organization's risks. The Current
220   Profile can then be used to support prioritization and measurement of progress toward the
221   Target Profile, while factoring in other business needs including cost-effectiveness and
222   innovation. Profiles can be used to conduct self-assessments and communicate within an
223   organization or between organizations.

1.2   Risk Management and the Cybersecurity Framework

225 Risk management is the ongoing process of identifying, assessing, and responding to risk. To
226 manage risk, organizations should understand the likelihood that an event will occur and the
227 resulting impact. With this information, organizations can determine the acceptable level of risk
228 for delivery of services and can express this as their risk tolerance.

229 With an understanding of risk tolerance, organizations can prioritize cybersecurity activities,
230 enabling organizations to make informed decisions about cybersecurity expenditures.
231 Implementation of risk management programs offers organizations the ability to quantify and
232 communicate adjustments to their cybersecurity programs. Organizations may choose to handle
233 risk in different ways, including mitigating the risk, transferring the risk, avoiding the risk, or
234 accepting the risk, depending on the potential impact to the delivery of critical services.

235 The Framework uses risk management processes to enable organizations to inform and prioritize
236 decisions regarding cybersecurity. It supports recurring risk assessments and validation of
237 business drivers to help organizations select target states for cybersecurity activities that reflect
238 desired outcomes. Thus, the Framework gives organizations the ability to dynamically select and
239 direct improvement in cybersecurity risk management for the IT and ICS environments.

240 The Framework is adaptive to provide a flexible and risk-based implementation that can be used
241 with a broad array of cybersecurity risk management processes. Examples of cybersecurity risk
242 management processes include International Organization for Standardization (ISO)
243 31000:2009[4], ISO/IEC 27005:2011[5], National Institute of Standards and Technology (NIST)
244 Special Publication (SP) 800-39[6], and the *Electricity Subsector Cybersecurity Risk Management*
245 *Process* (RMP) guideline[7].

1.3   Document Overview

247 The remainder of this document contains the following sections and appendices:
248 - Section 2 describes the Framework components: the Framework Core, the Tiers, and the
249   Profiles.
250 - Section 3 presents examples of how the Framework can be used.
251 - Section 4 describes how to use Framework for cybersecurity measurement.
252 - Appendix A presents the Framework Core in a tabular format: the Functions, Categories,
253   Subcategories, and Informative References.
254 - Appendix B contains a glossary of selected terms.
255 - Appendix C lists acronyms used in this document.
256 - Appendix D is a detailed listing of updates between the Framework Version 1.0 and 1.1.

---

[4] International Organization for Standardization, *Risk management – Principles and guidelines*, ISO 31000:2009, 2009. http://www.iso.org/iso/home/standards/iso31000.htm

[5] International Organization for Standardization/International Electrotechnical Commission, *Information technology – Security techniques – Information security risk management*, ISO/IEC 27005:2011, 2011. http://www.iso.org/iso/catalogue_detail?csnumber=56742

[6] Joint Task Force Transformation Initiative, *Managing Information Security Risk: Organization, Mission, and Information System View*, NIST Special Publication 800-39, March 2011. http://nvlpubs.nist.gov/nistpubs/Legacy/SP/nistspecialpublication800-39.pdf

[7] U.S. Department of Energy, *Electricity Subsector Cybersecurity Risk Management Process*, DOE/OE-0003, May 2012. https://energy.gov/sites/prod/files/Cybersecurity Risk Management Process Guideline - Final - May 2012.pdf

257 **2.0   Framework Basics**

258 The Framework provides a common language for understanding, managing, and expressing
259 cybersecurity risk both internally and externally. It can be used to help identify and prioritize
260 actions for reducing cybersecurity risk, and it is a tool for aligning policy, business, and
261 technological approaches to managing that risk. It can be used to manage cybersecurity risk
262 across entire organizations or it can be focused on the delivery of critical services within an
263 organization. Different types of entities – including sector coordinating structures, associations,
264 and organizations – can use the Framework for different purposes, including the creation of
265 common Profiles.

266 **2.1   Framework Core**

267 The *Framework Core* provides a set of activities to achieve specific cybersecurity outcomes, and
268 references examples of guidance to achieve those outcomes. The Core is not a checklist of
269 actions to perform. It presents key cybersecurity outcomes identified by industry as helpful in
270 managing cybersecurity risk. The Core comprises four elements: Functions, Categories,
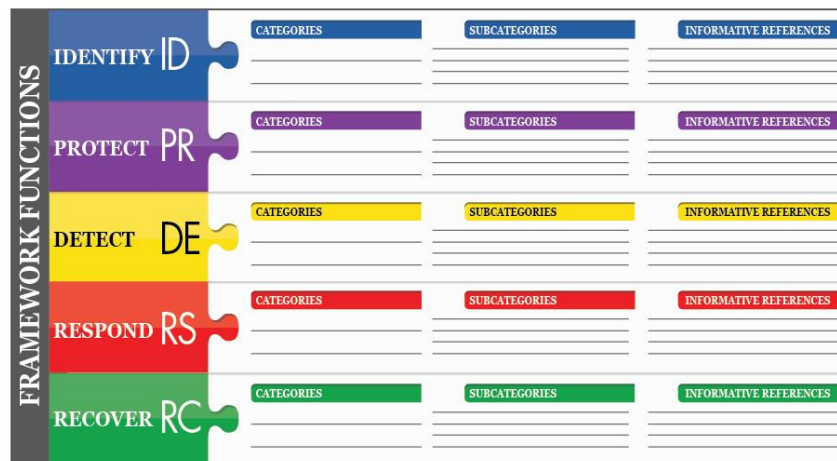271 Subcategories, and Informative References, depicted in **Figure 1**:

272

273   **Figure 1: Framework Core Structure**

274 The Framework Core elements work together as follows:

275 • **Functions** organize basic cybersecurity activities at their highest level. These Functions
276   are Identify, Protect, Detect, Respond, and Recover. They aid an organization in
277   expressing its management of cybersecurity risk by organizing information, enabling risk
278   management decisions, addressing threats, and improving by learning from previous
279   activities. The Functions also align with existing methodologies for incident management
280   and help show the impact of investments in cybersecurity. For example, investments in
281   planning and exercises support timely response and recovery actions, resulting in reduced
282   impact to the delivery of services.

7

283   • **Categories** are the subdivisions of a Function into groups of cybersecurity outcomes
284   closely tied to programmatic needs and particular activities. Examples of Categories
285   include "Asset Management," "Access Control," and "Detection Processes."

286   • **Subcategories** further divide a Category into specific outcomes of technical and/or
287   management activities. They provide a set of results that, while not exhaustive, help
288   support achievement of the outcomes in each Category. Examples of Subcategories
289   include "External information systems are catalogued," "Data-at-rest is protected," and
290   "Notifications from detection systems are investigated."

291   • **Informative References** are specific sections of standards, guidelines, and practices
292   common among critical infrastructure sectors that illustrate a method to achieve the
293   outcomes associated with each Subcategory. The Informative References presented in the
294   Framework Core are illustrative and not exhaustive. They are based upon cross-sector
295   guidance most frequently referenced during the Framework development process.[8]

296   The five Framework Core Functions are defined below. These Functions are not intended to
297   form a serial path, or lead to a static desired end state. Rather, the Functions can be performed
298   concurrently and continuously to form an operational culture that addresses the dynamic
299   cybersecurity risk. See Appendix A for the complete Framework Core listing.

300   • **Identify** – Develop the organizational understanding to manage cybersecurity risk to
301   systems, assets, data, and capabilities.

302   The activities in the Identify Function are foundational for effective use of the
303   Framework. Understanding the business context, the resources that support critical
304   functions, and the related cybersecurity risks enables an organization to focus and
305   prioritize its efforts, consistent with its risk management strategy and business needs.
306   Examples of outcome Categories within this Function include: Asset Management;
307   Business Environment; Governance; Risk Assessment; and Risk Management Strategy.

308   • **Protect** – Develop and implement the appropriate safeguards to ensure delivery of
309   critical infrastructure services.

310   The Protect Function supports the ability to limit or contain the impact of a potential
311   cybersecurity event. Examples of outcome Categories within this Function include:
312   Access Control; Awareness and Training; Data Security; Information Protection
313   Processes and Procedures; Maintenance; and Protective Technology.

314   • **Detect** – Develop and implement the appropriate activities to identify the occurrence of a
315   cybersecurity event.

316   The Detect Function enables timely discovery of cybersecurity events. Examples of
317   outcome Categories within this Function include: Anomalies and Events; Security
318   Continuous Monitoring; and Detection Processes.

---

[8] NIST developed a Compendium of informative references gathered from the Request for Information (RFI)
     input, Cybersecurity Framework workshops, and stakeholder engagement during the Framework development
     process. The Compendium includes standards, guidelines, and practices to assist with implementation. The
     Compendium is not intended to be an exhaustive list, but rather a starting point based on initial stakeholder
     input. The Compendium and other supporting material can be found at http://www.nist.gov/cyberframework/.

319 • **Respond** – Develop and implement the appropriate activities to take action regarding a
320   detected cybersecurity event.

321   The Respond Function supports the ability to contain the impact of a potential
322   cybersecurity event. Examples of outcome Categories within this Function include:
323   Response Planning; Communications; Analysis; Mitigation; and Improvements.

324 • **Recover** – Develop and implement the appropriate activities to maintain plans for
325   resilience and to restore any capabilities or services that were impaired due to a
326   cybersecurity event.

327   The Recover Function supports timely recovery to normal operations to reduce the
328   impact from a cybersecurity event. Examples of outcome Categories within this Function
329   include: Recovery Planning; Improvements; and Communications.

2.2 Framework Implementation Tiers

331 The Framework Implementation Tiers ("Tiers") provide context on how an organization views
332 cybersecurity risk and the processes in place to manage that risk. The Tiers range from Partial
333 (Tier 1) to Adaptive (Tier 4) and describe an increasing degree of rigor and sophistication in
334 cybersecurity risk management practices and the extent to which cybersecurity risk management
335 is informed by business needs and is integrated into an organization's overall risk management
336 practices. Risk management considerations include many aspects of cybersecurity, including the
337 degree to which privacy and civil liberties considerations are integrated into an organization's
338 management of cybersecurity risk and potential risk responses.

339 The Tier selection process considers an organization's current risk management practices, threat
340 environment, legal and regulatory requirements, information sharing practices, business/mission
341 objectives, cyber supply chain risk management needs, and organizational constraints.
342 Organizations should determine the desired Tier, ensuring that the selected level meets the
343 organizational goals, is feasible to implement, and reduces cybersecurity risk to critical assets
344 and resources to levels acceptable to the organization. Organizations should consider leveraging
345 external guidance obtained from Federal government departments and agencies, Information
346 Sharing and Analysis Centers (ISACs), existing maturity models, or other sources to assist in
347 determining their desired tier.

348 While organizations identified as Tier 1 (Partial) are encouraged to consider moving toward Tier
349 2 or greater, Tiers do not represent maturity levels. Progression to higher Tiers is encouraged
350 when such a change would reduce cybersecurity risk and be cost effective. Successful
351 implementation of the Framework is based upon achievement of the outcomes described in the
352 organization's Target Profile(s) and not upon Tier determination. However, Tier selection and
353 designation naturally affect Framework Profiles. The risk disposition expressed in a desired Tier
354 should influence prioritization within a Target Profile. Similarly, the organizational state
355 represented in an assessed Tier will indicate the likely findings of an assessed Profile, as well as
356 inform realistic progress in addressing Profile gaps.

357   The Tier definitions are as follows:

358   **Tier 1: Partial**

359   • *Risk Management Process* – Organizational cybersecurity risk management practices are
360   not formalized, and risk is managed in an *ad hoc* and sometimes reactive manner.
361   Prioritization of cybersecurity activities may not be directly informed by organizational
362   risk objectives, the threat environment, or business/mission requirements.

363   • *Integrated Risk Management Program* – There is limited awareness of cybersecurity risk
364   at the organizational level. The organization implements cybersecurity risk management
365   on an irregular, case-by-case basis due to varied experience or information gained from
366   outside sources. The organization may not have processes that enable cybersecurity
367   information to be shared within the organization.

368   • *External Participation* – An organization may not have the processes in place to
369   participate in coordination or collaboration with other entities.

370   • *Cyber Supply Chain Risk Management* – An organization may not understand the full
371   implications of cyber supply chain risks or have the processes in place to identify, assess
372   and mitigate its cyber supply chain risks.

373   **Tier 2: Risk Informed**

374   • *Risk Management Process* – Risk management practices are approved by management
375   but may not be established as organizational-wide policy. Prioritization of cybersecurity
376   activities is directly informed by organizational risk objectives, the threat environment, or
377   business/mission requirements.

378   • *Integrated Risk Management Program* – There is an awareness of cybersecurity risk at
379   the organizational level, but an organization-wide approach to managing cybersecurity
380   risk has not been established. Cybersecurity information is shared within the organization
381   on an informal basis. Consideration of cybersecurity in mission/business objectives may
382   occur at some levels of the organization, but not at all levels. Cyber risk assessment of
383   organizational assets is not typically repeatable or reoccurring.

384   • *External Participation* – The organization knows its role in the larger ecosystem, but has
385   not formalized its capabilities to interact and share information externally.

386   • *Cyber Supply Chain Risk Management* – The organization understands the cyber supply
387   chain risks associated with the products and services that either supports the business
388   mission function of the organization or that are utilized in the organization's products or
389   services. The organization has not formalized its capabilities to manage cyber supply
390   chain risks internally or with its suppliers and partners and performs these activities
391   inconsistently.

392   **Tier 3: Repeatable**

393   - *Risk Management Process* – The organization's risk management practices are formally
394   approved and expressed as policy. Organizational cybersecurity practices are regularly
395   updated based on the application of risk management processes to changes in
396   business/mission requirements and a changing threat and technology landscape.

397   - *Integrated Risk Management Program* – There is an organization-wide approach to
398   manage cybersecurity risk. Risk-informed policies, processes, and procedures are
399   defined, implemented as intended, and reviewed. Consistent methods are in place to
400   respond effectively to changes in risk. Personnel possess the knowledge and skills to
401   perform their appointed roles and responsibilities. The organization consistently and
402   accurately monitors cybersecurity risk of organizational assets. Senior cybersecurity and
403   non-cybersecurity executives communicate regularly regarding cybersecurity risk.
404   Senior executives ensure consideration of cybersecurity through all lines of operation in
405   the organization.

406   - *External Participation* – The organization understands its dependencies and partners and
407   receives information from these partners that enables collaboration and risk-based
408   management decisions within the organization in response to events.

409   - *Cyber Supply Chain Risk Management* – An organization-wide approach to managing
410   cyber supply chain risks is enacted via enterprise risk management policies, processes
411   and procedures. This likely includes a governance structure (e.g. Risk Council) that
412   manages cyber supply chain risks in balance with other enterprise risks. Policies,
413   processes, and procedures are implemented consistently, as intended, and continuously
414   monitored and reviewed. Personnel possess the knowledge and skills to perform their
415   appointed cyber supply chain risk management responsibilities. The organization has
416   formal agreements in place to communicate baseline requirements to its suppliers and
417   partners.

418   **Tier 4: Adaptive**

419   - *Risk Management Process* – The organization adapts its cybersecurity practices based on
420   lessons learned and predictive indicators derived from previous and current cybersecurity
421   activities. Through a process of continuous improvement incorporating advanced
422   cybersecurity technologies and practices, the organization actively adapts to a changing
423   cybersecurity landscape and responds to evolving and sophisticated threats in a timely
424   manner.

425   - *Integrated Risk Management Program* – There is an organization-wide approach to
426   managing cybersecurity risk that uses risk-informed policies, processes, and procedures
427   to address potential cybersecurity events. The relationship between cybersecurity risk and
428   mission/business objectives is clearly understood and considered when making decisions.
429   Senior executives monitor cybersecurity risk in the same context as financial risk and
430   other organizational risks. The organizational budget is based on understanding of current
431   and predicted risk environment and future risk appetites. Business units implement
432   executive vision and analyze system level risks in the context of the organizational risk
433   appetite and tolerances. Cybersecurity risk management is part of the organizational
434   culture and evolves from an awareness of previous activities, information shared by other

435   sources, and continuous awareness of activities on their systems and networks.
436   Cybersecurity risk is clearly articulated and understood across all strata of the enterprise.
437   The organization can quickly and efficiently account for changes to business/mission
438   objectives and threat and technology landscapes in how risk is communicated and
439   approached.

440   • *External Participation* – The organization manages risk and actively shares information
441   with partners to ensure that accurate, current information is being distributed and
442   consumed to improve cybersecurity before a cybersecurity event occurs.

443   • *Cyber Supply Chain Risk Management* – The organization can quickly and efficiently
444   account for emerging cyber supply chain risks using real-time or near real-time
445   information and leveraging an institutionalized knowledge of cyber supply chain risk
446   management with its external suppliers and partners as well as internally, in related
447   functional areas and at all levels of the organization. The organization communicates
448   proactively and uses formal (e.g. agreements) and informal mechanisms to develop and
449   maintain strong relationships with its suppliers, partners, and individual and
450   organizational buyers.

451   ## 2.3   Framework Profile

452   The Framework Profile ("Profile") is the alignment of the Functions, Categories, and
453   Subcategories with the business requirements, risk tolerance, and resources of the organization.
454   A Profile enables organizations to establish a roadmap for reducing cybersecurity risk that is well
455   aligned with organizational and sector goals, considers legal/regulatory requirements and
456   industry best practices, and reflects risk management priorities. Given the complexity of many
457   organizations, they may choose to have multiple profiles, aligned with particular components and
458   recognizing their individual needs.

459   Framework Profiles can be used to describe the current state or the desired target state of specific
460   cybersecurity activities. The Current Profile indicates the cybersecurity outcomes that are
461   currently being achieved. The Target Profile indicates the outcomes needed to achieve the
462   desired cybersecurity risk management goals. Profiles support business/mission requirements
463   and aid in the communication of risk within and between organizations. This Framework
464   document does not prescribe Profile templates, allowing for flexibility in implementation.

465   Comparison of Profiles (e.g., the Current Profile and Target Profile) may reveal gaps to be
466   addressed to meet cybersecurity risk management objectives. An action plan to address these
467   gaps can contribute to the roadmap described above. Prioritization of gap mitigation is driven by
468   the organization's business needs and risk management processes. This risk-based approach
469   enables an organization to gauge resource estimates (e.g., staffing, funding) to achieve
470   cybersecurity goals in a cost-effective, prioritized manner.

471　**2.4　Coordination of Framework Implementation**

472　**Figure 2** describes a common flow of information and decisions at the following levels within an
473　organization:

474　　• Executive
475　　• Business/Process
476　　• Implementation/Operations

477　The executive level communicates the mission priorities, available resources, and overall risk
478　tolerance to the business/process level. The business/process level uses the information as inputs
479　into the risk management process, and then collaborates with the implementation/operations
480　level to communicate business needs and create a Profile. The implementation/operations level
481　communicates the Profile implementation progress to the business/process level. The
482　business/process level uses this information to perform an impact assessment. Business/process
483　level management reports the outcomes of that impact assessment to the executive level to
484　inform the organization's overall risk management process and to the implementation/operations
485　level for awareness of business impact.
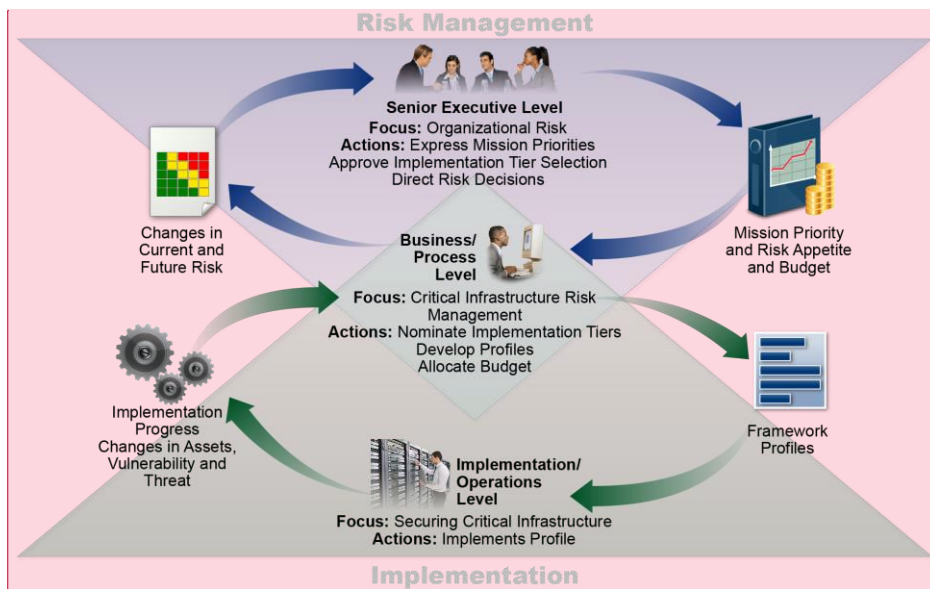
> **Commented [A1]:** Note addition of Implementation Tiers to the Actions in the figure.

486
487　**Figure 2: Notional Information and Decision Flows within an Organization**

3.0   How to Use the Framework

488

489 An organization can use the Framework as a key part of its systematic process for identifying,
490 assessing, and managing cybersecurity risk. The Framework is not designed to replace existing
491 processes; an organization can use its current process and overlay it onto the Framework to
492 determine gaps in its current cybersecurity risk approach and develop a roadmap to
493 improvement. Utilizing the Framework as a cybersecurity risk management tool, an organization
494 can determine activities that are most important to critical service delivery and prioritize
495 expenditures to maximize the impact of the investment.

496 The Framework is designed to complement existing business and cybersecurity operations. It can
497 serve as the foundation for a new cybersecurity program or a mechanism for improving an
498 existing program. The Framework provides a means of expressing cybersecurity requirements to
499 business partners and customers and can help identify gaps in an organization's cybersecurity
500 practices. It also provides a general set of considerations and processes for considering privacy
501 and civil liberties implications in the context of a cybersecurity program.

502 The Framework can be applied in design, build/buy, deploy, operate, and decommission system
503 lifecycle phases. The design phase should account for cybersecurity requirements as a part of a
504 larger multi-disciplinary systems engineering process[9]. A key milestone of the design phase is
505 validation that the system cybersecurity specifications match the needs and risk disposition of the
506 organization as summarized in a Framework Profile. The cybersecurity outcomes prioritized in a
507 Profile should be enacted during either a) development of the system during the build phase or b)
508 purchase or outsourcing of the system during the buy phase. In the system deploy phase, the
509 cybersecurity features of the system should be assessed to verify the design was enacted. The
510 cybersecurity outcomes of the Framework then serve as a basis for on-going operation of the
511 system, including occasional reassessment to verify that cybersecurity requirements are still
512 fulfilled. Typically, a complex web of dependencies amongst systems means Framework
513 outcomes should be carefully considered as one or more systems are decommissioned.

514 The following sections present different ways in which organizations can use the Framework.

3.1   Basic Review of Cybersecurity Practices

515

516 The Framework can be used to compare an organization's current cybersecurity activities with
517 those outlined in the Framework Core. Through the creation of a Current Profile, organizations
518 can examine the extent to which they are achieving the outcomes described in the Core
519 Categories and Subcategories, aligned with the five high-level Functions: Identify, Protect,
520 Detect, Respond, and Recover. An organization may find that it is already achieving the desired
521 outcomes, thus managing cybersecurity commensurate with the known risk. Conversely, an
522 organization may determine that it has opportunities to (or needs to) improve. The organization
523 can use that information to develop an action plan to strengthen existing cybersecurity practices
524 and reduce cybersecurity risk. An organization may also find that it is overinvesting to achieve

---

[9] NIST Special Publication 800-160: *System Security Engineering, Considerations for a Multidisciplinary Approach in the Engineering of Trustworthy Secure Systems*, Ross et al, November 2016, http://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-160.pdf

525   certain outcomes. The organization can use this information to reprioritize resources to
526   strengthen other cybersecurity practices.

527   While they do not replace a risk management process, these five high-level Functions will
528   provide a concise way for senior executives and others to distill the fundamental concepts of
529   cybersecurity risk so that they can assess how identified risks are managed, and how their
530   organization stacks up at a high level against existing cybersecurity standards, guidelines, and
531   practices. The Framework can also help an organization answer fundamental questions,
532   including "How are we doing?" Then they can move in a more informed way to strengthen their
533   cybersecurity practices where and when deemed necessary.

3.2   Establishing or Improving a Cybersecurity Program

535   The following steps illustrate how an organization could use the Framework to create a new
536   cybersecurity program or improve an existing program. These steps should be repeated as
537   necessary to continuously improve cybersecurity.

538   **Step 1: Prioritize and Scope**. The organization identifies its business/mission objectives and
539   high-level organizational priorities. With this information, the organization makes strategic
540   decisions regarding cybersecurity implementations and determines the scope of systems and
541   assets that support the selected business line or process. The Framework can be adapted to
542   support the different business lines or processes within an organization, which may have
543   different business needs and associated risk tolerance. Implementation Tiers may be used to
544   express varying risk tolerances.

545   **Step 2: Orient**. Once the scope of the cybersecurity program has been determined for the
546   business line or process, the organization identifies related systems and assets, regulatory
547   requirements, and overall risk approach. The organization then consults sources to identify
548   threats and vulnerabilities applicable to those systems and assets. identifies threats to, and
549   vulnerabilities of, those systems and assets.

550   **Step 3: Create a Current Profile**. The organization develops a Current Profile by indicating
551   which Category and Subcategory outcomes from the Framework Core are currently being
552   achieved. If an outcome is partially achieved, noting this fact will help support subsequent steps.

553   **Step 4: Conduct a Risk Assessment**. This assessment could be guided by the organization's
554   overall risk management process or previous risk assessment activities. The organization
555   analyzes the operational environment in order to discern the likelihood of a cybersecurity event
556   and the impact that the event could have on the organization. It is important that organizations
557   identify emerging risks and use cyber threat information from internal and external sources to
558   gain a better understanding of the likelihood and impact of cybersecurity events.

559   **Step 5: Create a Target Profile**. The organization creates a Target Profile that focuses on the
560   assessment of the Framework Categories and Subcategories describing the organization's desired
561   cybersecurity outcomes. Organizations also may develop their own additional Categories and
562   Subcategories to account for unique organizational risks. The organization may also consider
563   influences and requirements of external stakeholders such as sector entities, customers, and
564   business partners when creating a Target Profile. When used in conjunction with an

565 Implementation Tier, characteristics of the Tier level should be reflected in the desired
566 cybersecurity outcomes.

567 **Step 6: Determine, Analyze, and Prioritize Gaps**. The organization compares the Current
568 Profile and the Target Profile to determine gaps. Next, it creates a prioritized action plan to
569 address those gaps that draws upon mission drivers, a cost/benefit analysis, and understanding of
570 risk to achieve the outcomes in the Target Profile - drawing upon mission drivers, a cost/benefit
571 analysis, and risk understanding - to achieve the outcomes in the Target Profile. The organization
572 then determines resources necessary to address the gaps. Using Profiles in this manner enables
573 the organization to make informed decisions about cybersecurity activities, supports risk
574 management, and enables the organization to perform cost-effective, targeted improvements.

575 **Step 7: Implement Action Plan**. The organization determines which actions to take in regards
576 to the gaps, if any, identified in the previous step. It then monitors its current cybersecurity
577 practices against the Target Profile. For further guidance, the Framework identifies example
578 Informative References regarding the Categories and Subcategories, but organizations should
579 determine which standards, guidelines, and practices, including those that are sector specific,
580 work best for their needs.

581 An organization may repeat the steps as needed to continuously assess and improve its
582 cybersecurity. For instance, organizations may find that more frequent repetition of the orient
583 step improves the quality of risk assessments. Furthermore, organizations may monitor progress
584 through iterative updates to the Current Profile, subsequently comparing the Current Profile to
585 the Target Profile. Organizations may also utilize this process to align their cybersecurity
586 program with their desired Framework Implementation Tier.

587 ## 3.3   Communicating Cybersecurity Requirements with Stakeholders

588 The Framework provides a common language to communicate requirements among
589 interdependent stakeholders responsible for the delivery of essential critical infrastructure
590 services. Examples include:

591 • An organization may utilize a Target Profile to express cybersecurity risk management
592   requirements to an external service provider (e.g., a cloud provider to which it is
593   exporting data).
594 • An organization may express its cybersecurity state through a Current Profile to report
595   results or to compare with acquisition requirements.
596 • A critical infrastructure owner/operator, having identified an external partner on whom
597   that infrastructure depends, may use a Target Profile to convey required Categories and
598   Subcategories.
599 • A critical infrastructure sector may establish a Target Profile that can be used among its
600   constituents as an initial baseline Profile to build their tailored Target Profiles.

601 In addition, Implementation Tiers allow organizations to understand how they fit into the larger
602 cybersecurity ecosystem. Organizations can better manager cybersecurity risk amongst
603 stakeholders by assessing their position in both critical infrastructure and the broader digital
604 economy.

605 The practice of communicating and verifying cybersecurity requirements among stakeholders is
606 one aspect of cyber supply chain risk management (SCRM). A primary objective of cyber
607 SCRM is to identify, assess and mitigate "products and services that may contain potentially
608 malicious functionality, are counterfeit, or are vulnerable due to poor manufacturing and
609 development practices within the cyber supply chain.[10]" Cyber SCRM activities may include:

610 - Determining cybersecurity requirements for suppliers and information technology
611   (IT) and operational technology (OT) partners,
612 - Enacting cybersecurity requirements through formal agreement (e.g. contracts),
613 - Communicating to suppliers and partners how those cybersecurity requirements will
614   be verified and validated,
615 - Verify cybersecurity requirements are met through a variety of assessment
616   methodologies, and
617 - Governing and managing the above activities.

618 As depicted in Figure 3, cyber SCRM encompasses IT and OT suppliers and buyers as well as
619 non-IT and OT partners. These relationships highlight the critical role of cyber SCRM in
620 addressing cybersecurity risk in the critical infrastructure and the broader digital economy. They
621 should be identified and factored into the protective and detective capabilities of organizations,
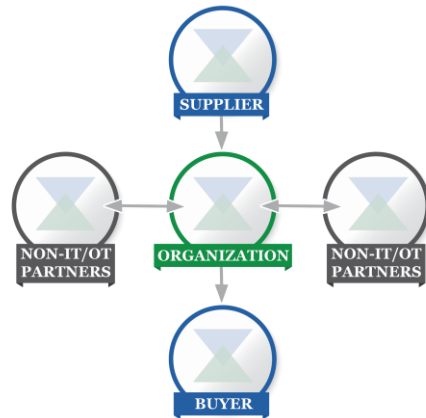622 as well as the response and recovery protocols of organizations.

623

624 **Figure 3: Cyber Supply Chain Relationship**

625 Buyer refers to the people or organizations that consume a given product or service from an
626 organization. Suppliers encompass product and service providers that are used for an
627 organization's internal purposes (e.g., IT infrastructure) or integrated into the products or
628 services provided to the Buyer. Finally, non-IT and OT partners have access to, or may otherwise
629 be a risk to, the security posture of the organization.

---

[10] NIST Special Publication 800-161: *Supply Chain Risk Management Practices for Federal Information Systems and Organizations*, Boyens et al, April 2015, http://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-161.pdf

Formatted: Font: (Default) +Headings CS (Times New Roman)

630 Whether considering individual Subcategories of the Core, or the comprehensive considerations
631 of a Profile, the Framework offers organizations and their partners a method of ensuring the new
632 product or service meets security outcomes that are prioritized. By first selecting outcomes that
633 are relevant to the context (PII transmission, mission critical service delivery, data verification
634 services, product or service integrity, etc.) the organization can then evaluate partners against
635 those criteria. For example, if a particular system is being purchased that will monitor OT,
636 availability may be a particularly important cybersecurity objective to achieve and thus will drive
637 Subcategory selection (ID.BE-4, ID.SC-3, ID.SC-4, ID.SC-5, PR.DS-4, PR.DS-6, PR.DS-7,
638 PR.DS-8, PR.IP-1, DE.AE-5, etc.).

3.4   Buying Decisions

640 Since a Framework Target Profile is a prioritized list of organizational cybersecurity
641 requirements, Target Profiles can be used to inform decisions about buying products and
642 services. This transaction varies from cyber SCRM (Section 3.3) in that it may not be possible to
643 impose a set of cybersecurity requirements on the supplier. Instead, the objective is to make the
644 best buying decision, optimally between multiple suppliers, given a pre-decided list of
645 cybersecurity requirements. Often, this means some degree of trade-off analysis. Therefore, a
646 product or service is typically purchased with known gaps to the Target Profile.

647 Once a product or service is purchased, the Profile also can be used to track residual
648 cybersecurity risk. For example, if the service or product purchased did not meet all the
649 objectives described in the Target Profile, the organization can incorporate that residual
650 cybersecurity risk into the overall risk management of the larger environment, addressing the
651 residual risk through other management actions. The Profile also allows the organization a
652 method for assuring that the product meets cybersecurity outcomes through periodic review and
653 testing mechanisms.

3.45   Identifying Opportunities for New or Revised Informative References

656 The Framework can be used to identify opportunities for new or revised standards, guidelines, or
657 practices where additional Informative References would help organizations address emerging
658 needs. An organization implementing a given Subcategory, or developing a new Subcategory,
659 might discover that there are few Informative References, if any, for a related activity. To
660 address that need, the organization might collaborate with technology leaders and/or standards
661 bodies to draft, develop, and coordinate standards, guidelines, or practices.

3.56   Methodology to Protect Privacy and Civil Liberties

663 This section describes a methodology as required by the Executive Order to address individual
664 privacy and civil liberties implications that may result from cybersecurity operations. This
665 methodology is intended to be a general set of considerations and processes since privacy and
666 civil liberties implications may differ by sector or over time and organizations may address these
667 considerations and processes with a range of technical implementations. Nonetheless, not all
668 activities in a cybersecurity program may give rise to these considerations. Consistent with
669 Section 3.4, technical privacy standards, guidelines, and additional best practices may need to be
670 developed to support improved technical implementations.

671   Privacy and cybersecurity have a strong nexus. It is well-recognized that cybersecurity plays an
672   important role in protecting individuals' privacy; for example, with respect to the confidentiality
673   of assets containing personal information. Nonetheless, an organization's cybersecurity activities
674   also can create risks to privacy and civil liberties~~and civil liberties implications may arise~~ when
675   personal information is used, collected, processed, maintained, or disclosed in connection with
676   an organization's cybersecurity activities. Some examples of activities that bear privacy or civil
677   liberties considerations may include: cybersecurity activities that result in the over-collection or
678   over-retention of personal information; disclosure or use of personal information unrelated to
679   cybersecurity activities; cybersecurity mitigation activities that result in denial of service or other
680   similar potentially adverse impacts, including activities such as some types of incident detection
681   or monitoring that may impact freedom of expression or association.

682   The government and agents of the government have a direct responsibility to protect civil
683   liberties arising from cybersecurity activities. As referenced in the methodology below,
684   government or agents of the government that own or operate critical infrastructure should have a
685   process in place to support compliance of cybersecurity activities with applicable privacy laws,
686   regulations, and Constitutional requirements.

687   To address privacy implications, organizations may consider how, in circumstances where such
688   measures are appropriate, their cybersecurity program might incorporate privacy principles such
689   as: data minimization in the collection, disclosure, and retention of personal information material
690   related to the cybersecurity incident; use limitations outside of cybersecurity activities on any
691   information collected specifically for cybersecurity activities; transparency for certain
692   cybersecurity activities; individual consent and redress for adverse impacts arising from use of
693   personal information in cybersecurity activities; data quality, integrity, and security; and
694   accountability and auditing.

695   As organizations assess the Framework Core in Appendix A, the following processes and
696   activities may be considered as a means to address the above-referenced privacy and civil
697   liberties implications:

698   **Governance of cybersecurity risk**

699   - An organization's assessment of cybersecurity risk and potential risk responses considers
700   the privacy implications of its cybersecurity program
701   - Individuals with cybersecurity-related privacy responsibilities report to appropriate
702   management and are appropriately trained
703   - Process is in place to support compliance of cybersecurity activities with applicable
704   privacy laws, regulations, and Constitutional requirements
705   - Process is in place to assess implementation of the foregoing organizational measures and
706   controls

707   **Approaches to identifying and authorizing individuals to access organizational assets and**
708   **systems**

709   - Steps are taken to identify and address the privacy implications of access control
710   measures to the extent that they involve collection, disclosure, or use of personal
711   information

712 **Awareness and training measures**

713   • Applicable information from organizational privacy policies is included in cybersecurity
714   workforce training and awareness activities
715   • Service providers that provide cybersecurity-related services for the organization are
716   informed about the organization's applicable privacy policies

717 **Anomalous activity detection and system and assets monitoring**

718   • Process is in place to conduct a privacy review of an organization's anomalous activity
719   detection and cybersecurity monitoring

720 **Response activities, including information sharing or other mitigation efforts**

721   • Process is in place to assess and address whether, when, how, and the extent to which
722   personal information is shared outside the organization as part of cybersecurity
723   information sharing activities
724   • Process is in place to conduct a privacy review of an organization's cybersecurity
725   mitigation efforts

726 ## 3.7   Federal Alignment

727 For Federal information systems, including those systems that are part of the critical
728 infrastructure, Federal agencies are required to fulfill the security requirements defined in the
729 Federal Information Security Modernization Act (FISMA), Office of Management and Budget
730 (OMB) policies, and NIST standards and guidelines as expressed in Federal Information
731 Processing Standards and Special Publications. The Cybersecurity Framework complements
732 existing federal risk management approaches. Federal agencies may find the Framework a
733 valuable addition by using:

734   • Implementation Tiers to express risk disposition,
735   • The Core to organize and communicate cybersecurity concepts, activities, and outcomes,
736   • Profiles to inform prioritization decisions, and
737   • The Seven-Step Process to organize assessment and remediation activities.

738 Additionally, OMB has organized recent FISMA reporting[11] and improvement initiatives (e.g.,
739 Cybersecurity Strategy and Implementation Plan[12]) according to Framework Functions. Federal
740 organizations may find value in gaining a working understanding of the Framework Core to
741 ensure precise and efficient high-level cybersecurity dialog with Federal and non-Federal
742 partners.

---

[11] OMB Memorandum M-16-03, *FY 2015-16 Guidance on Federal Information Security and Privacy Management Requirements*, http://dpcld.defense.gov/Portals/49/Documents/Privacy/Memorandum/OMBMemorandumM-16-03.pdf
[12] OMB Memorandum M-16-04, *Cybersecurity Strategy and Implementation Plan*, http://dpcld.defense.gov/Portals/49/Documents/Privacy/Memorandum/OMBMemorandumM-16-04.pdf

4.0   Measuring and Demonstrating Cybersecurity

Framework measurement provides a basis for strong trusted relationships, both inside and outside of an organization. Measuring state and trends over time, internally, through external audit, and through conformity assessment, enables an organization to understand and convey meaningful risk information to dependents, partners, and customers.

In combination with Informative References, the Framework can be used as the basis for comprehensive measurement. The key terms for measuring with Framework are "metrics" and "measures.[13]" Metrics are used to "facilitate decision making and improve performance and accountability." The Implementation Tiers, Subcategories, and Categories are examples of metrics. Metrics create meaning and awareness of organizational security postures by aggregating and correlating measures. Measures are "quantifiable, observable, objective data supporting metrics." Measures are most closely aligned with technical controls, such as the Informative References.

The information harvested from security metrics is indicative of different aspects of organizational cyber risk posture. As such, tracking both security metrics and business outcomes may provide meaningful insight as to how changes in granular security controls impact the completion of business objectives. While it is important to measure whether or not a business objective was achieved through lagging measurement, it is typically more important to understand the likelihood of achieving a future objective through a leading measurement.

The ability of an organization to determine cause-and-effect relationships between cybersecurity and business outcomes is dependent on the accuracy and precision of the measurement systems (i.e., composed of the "resources" highlighted in ID.AM-5). Therefore, the measurement system should be designed with business requirements and operating expense in mind. The expense of a measurement system may increase as the accuracy of measurement increases. To mitigate undue cost to the organization, the accuracy and expense of a system need only match the required measurement accuracy of the corresponding business objective.

4.1   Correlation to Business Results

The objective of measuring cybersecurity is to correlate cybersecurity with business objectives (ID.BE-3), to understand and quantify cause-and-effect. Common business objectives include driving business/mission results, increasing cost effectiveness, and reducing enterprise risk. The aggregate of these business objectives may be measured in earnings per share and price/earnings multiple at the board level: revenue and net profits by senior executives; and in more specific measures such as number of products or hours delivered by those that report to senior executives.

Correlating cybersecurity metrics to business objectives is often more complex than simply measuring one cybersecurity result. There are a large number and variety of contributing factors to a given business objective. For instance, a retail bank wanting to increase the number of on-line banking customers may seek to do so by implementing stronger authentication. However, achieving an increase in on-line banking customers is also contingent upon developing the messages regarding trusted on-line transactions, targeting specific demographics of consumers,

---

[13] *Cybersecuritry Metrics and Measures*, Black et al, March 2009, http://ws680.nist.gov/publication/get_pdf.cfm?pub_id=51292

782 selecting communication channels that are most meaningful to those demographics, and
783 marketing those communication channels over a duration necessary to achieve the objective. In
784 short, achieving customer growth is contingent on messaging, marketing, advertising
785 cybersecurity, and other factors.

786 The relative cost effectiveness of various cybersecurity activities is an important consideration.
787 Cost effectiveness means achieving a given business objective using minimum cybersecurity
788 effort and expense. To examine cost effectiveness, an organization must first have a clear
789 understanding of the business objectives, an understanding of the relationship between business
790 objectives and the cybersecurity metrics, and an understanding of the relationship between
791 business objectives and non-cybersecurity factors.

792 The effect of cybersecurity outcomes on a business objective may often be unclear.
793 Cybersecurity's primary role is the preservation of the businesses value through the protection of
794 the confidentiality, integrity, and availability (CIA) of the organization's information, operations,
795 and processes. As such, even when cost effectiveness or the effect of cybersecurity outcomes on
796 a business objective are unclear, organizations should exercise prudence when modifying their
797 cybersecurity program. Often, cybersecurity outcomes are preventing a bad business
798 circumstance, like a data breach.

799 Enterprise risk management is the consideration of all risks to achieving a given business
800 objective. Ensuring cybersecurity is factored into enterprise risk consideration is integral to
801 achieving business objectives. This includes the positive effects of cybersecurity as well as the
802 negative effects should cybersecurity be subverted. The Management metrics highlighted below
803 are a way of aggregating cybersecurity risk using the Framework Core, enabling cybersecurity
804 can be factored into enterprise risk management.

805 The ability of an organization to determine cause-and-effect relationships between cybersecurity
806 outcomes and business objectives also depends on the ability to adequately isolate those
807 cybersecurity outcomes and business objectives. This is one of the largest challenges affecting
808 measurement of cybersecurity. Special care must be taken to ensure that a given cybersecurity
809 outcome and business objective truly correlate. Generally, correlating cybersecurity measures to
810 higher-level cybersecurity metrics is easier than correlating cybersecurity metrics to business
811 metrics.

812   **4.2   Types of Cybersecurity Measurement**

813   A summary of metrics and measures relating to the Framework is displayed in Table 1.

814   **Table 1: Types of Framework Measurement**

Measurement	What is Measured	Corresponding Framework Component	Measurement Type
Practices	General risk management behaviors	Implementation Tiers	Metric
Process	Specific risk management activities	Prose of Framework including the Seven-Step Process (Section 3.2) and use case specific process (e.g., Section 3.3 & 3.6)	Measure
Management	Fulfillment of general cybersecurity outcomes	Core/Profile Functions, Categories, and Subcategories	Metric
Technical	Achievement of specific cybersecurity outcomes	Informative References	Measure

815

816   Framework Implementation Tiers are a qualitative metric of overall cybersecurity risk
817   management practices. Beyond an overarching 1 – 4 qualitative metric, the individual
818   Implementation Tier properties of Risk Management Process, Integrated Risk Management
819   Program, External Participation, and Cyber Supply Chain Risk Management also comprise
820   practice metrics.

821   Whereas practices such as those in Implementation Tiers are general trends in high-level
822   organizational behavior, those practices are composed of discrete processes that represent
823   specific risk management activities. For instance, the periodicity of a process for updating
824   Framework Profiles (Step 3) is a measure that is reflected in the metric, Risk Management
825   Process. Similarly, a measure of the extent that governance and risk management processes
826   address cybersecurity risk (ID.GV-4) is reflected in the metric, Integrated Risk Management
827   Program. Finally, the volume of threat and vulnerability information received from information
828   sharing forums and sources (ID.RA-2) is reflected in the metric, External Participation.

829 The cybersecurity outcomes of the Framework Core are the basis for a comprehensive set of
830 cybersecurity management metrics. The aggregate of these metrics equals a reduction (or not) of
831 cybersecurity risk.

832 • For instance, the outcome of the Protect Function is to "develop and implement the
833 appropriate safeguards to *ensure delivery…*" A Senior executive held accountable to this
834 outcome might be measured using a lagging metric of percentage uptime of system(s)
835 (i.e. ensuring delivery), with a leading metric of creating and communicating *strategy* for
836 development and implementation for data security.
837 • Correspondingly, a Business Process person might be held accountable to the Data
838 Security Category of the Protect Function (PR.DS) and Subcategories thereof. Data
839 Security reads "information and records (data) are managed consistent with the
840 organization's risk strategy to protect the CIA of information." A Business Process
841 person accountable for all Data Security could be measured using the leading metric of
842 whether *policies* are published and communicated commensurate with both the
843 organizations risk strategy and the goals of CIA. Lagging metrics for this Business
844 Process person might be a composite of lagging metrics of how CIA is managed by those
845 responsible for the Data Security Subcategories.
846 • Similarly, the Implementation/Operations person accountable for protecting data-at-rest
847 (PR.DS-1) might be measured on the leading metric of implementing protective
848 mechanisms, with the lagging metric being whether data was protected as evidenced by
849 the lack of unauthorized modification, deletion, or theft of organizational data. That
850 Implementation/Operations person might fulfill the objective of PR.DS-1 using
851 applicable Informative References and corresponding measures.

852 Informative References, such as controls catalogs, offer detailed technical measures that work
853 modularly to complement Framework. For instance, an organization using the NIST Special
854 Publication 800-53[14] security control SP-28 to implement the PR.DS-1 Subcategory might be
855 held accountable to measures of design, development/purchase, implementation, management,
856 evolution, and sunset of:

857 • Cryptographic mechanisms across a variety of media storage (internally-hosted hard
858 drives, cloud hard drives, portable storage devices, mobile devices)
859 • Full disk encryption versus specific data structures (e.g., files, records, or fields),
860 • File share scanning,
861 • Write-Once-Read-Many technologies, and
862 • Secure off-line storage in lieu of online storage.

---

[14] NIST Special Publication 800-53 Revision 4: *Security and Privacy Controls for Federal Information Systems and Organizations*, Joint Task Force Transformation Initiative Interagency Working Group, April 2013, http://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-53r4.pdf

Appendix A: Framework Core

Note to Reviewers:
NIST is currently working with various parties to further refine and update the Informative
References illustrated in the Core. These updates are still pending.

This appendix presents the Framework Core: a listing of Functions, Categories, Subcategories,
and Informative References that describe specific cybersecurity activities that are common
across all critical infrastructure sectors. The chosen presentation format for the Framework Core
does not suggest a specific implementation order or imply a degree of importance of the
Categories, Subcategories, and Informative References. The Framework Core presented in this
appendix represents a common set of activities for managing cybersecurity risk. While the
Framework is not exhaustive, it is extensible, allowing organizations, sectors, and other entities
to use Subcategories and Informative References that are cost-effective and efficient and that
enable them to manage their cybersecurity risk. Activities can be selected from the Framework
Core during the Profile creation process and additional Categories, Subcategories, and
Informative References may be added to the Profile. An organization's risk management
processes, legal/regulatory requirements, business/mission objectives, and organizational
constraints guide the selection of these activities during Profile creation. Personal information is
considered a component of data or assets referenced in the Categories when assessing security
risks and protections.

While the intended outcomes identified in the Functions, Categories, and Subcategories are the
same for IT and ICS, the operational environments and considerations for IT and ICS differ. ICS
have a direct effect on the physical world, including potential risks to the health and safety of
individuals, and impact on the environment. Additionally, ICS have unique performance and
reliability requirements compared with IT, and the goals of safety and efficiency must be
considered when implementing cybersecurity measures.

For ease of use, each component of the Framework Core is given a unique identifier. Functions
and Categories each have a unique alphabetic identifier, as shown in Table 1. Subcategories
within each Category are referenced numerically; the unique identifier for each Subcategory is
included in Table 2.

Additional supporting material relating to the Framework can be found on the NIST website at
http://www.nist.gov/cyberframework/.

Table 12: Function and Category Unique Identifiers

894

Function Unique Identifier	Function	Category Unique Identifier	Category
ID	Identify	ID.AM	Asset Management
		ID.BE	Business Environment
		ID.GV	Governance
		ID.RA	Risk Assessment
		ID.RM	Risk Management Strategy
		ID.SC	Supply Chain Risk Management
PR	Protect	PR.AC	Access Control
		PR.AT	Awareness and Training
		PR.DS	Data Security
		PR.IP	Information Protection Processes and Procedures
		PR.MA	Maintenance
		PR.PT	Protective Technology
DE	Detect	DE.AE	Anomalies and Events
		DE.CM	Security Continuous Monitoring
		DE.DP	Detection Processes
RS	Respond	RS.RP	Response Planning
		RS.CO	Communications
		RS.AN	Analysis
		RS.MI	Mitigation
		RS.IM	Improvements
RC	Recover	RC.RP	Recovery Planning
		RC.IM	Improvements
		RC.CO	Communications

895

Table 23: Framework Core

Function	Category	Subcategory	Informative References
IDENTIFY (ID)	**Asset Management (ID.AM):** The data, personnel, devices, systems, and facilities that enable the organization to achieve business purposes are identified and managed consistent with their relative importance to business objectives and the organization's risk strategy.	**ID.AM-1**: Physical devices and systems within the organization are inventoried	• **CCS CSC** 1 • **COBIT 5** BAI09.01, BAI09.02 • **ISA 62443-2-1:2009** 4.2.3.4 • **ISA 62443-3-3:2013** SR 7.8 • **ISO/IEC 27001:2013** A.8.1.1, A.8.1.2 • **NIST SP 800-53 Rev. 4** CM-8
		ID.AM-2: Software platforms and applications within the organization are inventoried	• **CCS CSC** 2 • **COBIT 5** BAI09.01, BAI09.02, BAI09.05 • **ISA 62443-2-1:2009** 4.2.3.4 • **ISA 62443-3-3:2013** SR 7.8 • **ISO/IEC 27001:2013** A.8.1.1, A.8.1.2 • **NIST SP 800-53 Rev. 4** CM-8
		ID.AM-3: Organizational communication and data flows are mapped	• **CCS CSC** 1 • **COBIT 5** DSS05.02 • **ISA 62443-2-1:2009** 4.2.3.4 • **ISO/IEC 27001:2013** A.13.2.1 • **NIST SP 800-53 Rev. 4** AC-4, CA-3, CA-9, PL-8
		ID.AM-4: External information systems are catalogued	• **COBIT 5** APO02.02 • **ISO/IEC 27001:2013** A.11.2.6 • **NIST SP 800-53 Rev. 4** AC-20, SA-9
		ID.AM-5: Resources (e.g., hardware, devices, data, time, and software) are prioritized based on their classification, criticality, and business value	• **COBIT 5** APO03.03, APO03.04, BAI09.02 • **ISA 62443-2-1:2009** 4.2.3.6 • **ISO/IEC 27001:2013** A.8.2.1 • **NIST SP 800-53 Rev. 4** CP-2, RA-2, SA-14
		ID.AM-6: Cybersecurity roles and responsibilities for the entire workforce and third-party stakeholders (e.g., suppliers, customers, partners) are established	• **COBIT 5** APO01.02, DSS06.03 • **ISA 62443-2-1:2009** 4.3.2.3.3 • **ISO/IEC 27001:2013** A.6.1.1

Function	Category	Subcategory	Informative References
			• **NIST SP 800-53 Rev. 4** CP-2, PS-7, PM-11
	Business Environment (ID.BE): The organization's mission, objectives, stakeholders, and activities are understood and prioritized; this information is used to inform cybersecurity roles, responsibilities, and risk management decisions.	**ID.BE-1:** The organization's role in the supply chain is identified and communicated	• **COBIT 5** APO08.04, APO08.05, APO10.03, APO10.04, APO10.05 • **ISO/IEC 27001:2013** A.15.1.3, A.15.2.1, A.15.2.2 • **NIST SP 800-53 Rev. 4** CP-2, SA-12
		ID.BE-2: The organization's place in critical infrastructure and its industry sector is identified and communicated	• **COBIT 5** APO02.06, APO03.01 • **NIST SP 800-53 Rev. 4** PM-8
		ID.BE-3: Priorities for organizational mission, objectives, and activities are established and communicated	• **COBIT 5** APO02.01, APO02.06, APO03.01 • **ISA 62443-2-1:2009** 4.2.2.1, 4.2.3.6 • **NIST SP 800-53 Rev. 4** PM-11, SA-14
		ID.BE-4: Dependencies and critical functions for delivery of critical services are established	• **ISO/IEC 27001:2013** A.11.2.2, A.11.2.3, A.12.1.3 • **NIST SP 800-53 Rev. 4** CP-8, PE-9, PE-11, PM-8, SA-14
		ID.BE-5: Resilience requirements to support delivery of critical services are established for all operating states (e.g. under duress/attack, during recovery, normal operations)	• **COBIT 5** DSS04.02 • **ISO/IEC 27001:2013** A.11.1.4, A.17.1.1, A.17.1.2, A.17.2.1 • **NIST SP 800-53 Rev. 4** CP-2, CP-11, SA-14
	Governance (ID.GV): The policies, procedures, and processes to manage and monitor the organization's regulatory, legal, risk, environmental, and operational requirements are understood and inform the management of cybersecurity risk.	**ID.GV-1:** Organizational information security policy is established	• **COBIT 5** APO01.03, EDM01.01, EDM01.02 • **ISA 62443-2-1:2009** 4.3.2.6 • **ISO/IEC 27001:2013** A.5.1.1 • **NIST SP 800-53 Rev. 4** -1 controls from all families
		ID.GV-2: Information security roles & responsibilities are coordinated and aligned with internal roles and external partners	• **COBIT 5** APO13.01 • **ISA 62443-2-1:2009** 4.3.2.3.3 • **ISO/IEC 27001:2013** A.6.1.1, A.7.2.1 • **NIST SP 800-53 Rev. 4** PM-1, PS-7
		ID.GV-3: Legal and regulatory requirements regarding cybersecurity,	• **COBIT 5** MEA03.01, MEA03.04

Function	Category	Subcategory	Informative References
		including privacy and civil liberties obligations, are understood and managed	• **ISA 62443-2-1:2009** 4.4.3.7 • **ISO/IEC 27001:2013** A.18.1 • **NIST SP 800-53 Rev. 4** -1 controls from all families (except PM-1)
		ID.GV-4: Governance and risk management processes address cybersecurity risks	• **COBIT 5** DSS04.02 • **ISA 62443-2-1:2009** 4.2.3.1, 4.2.3.3, 4.2.3.8, 4.2.3.9, 4.2.3.11, 4.3.2.4.3, 4.3.2.6.3 • **NIST SP 800-53 Rev. 4** PM-9, PM-11
	Risk Assessment (ID.RA): The organization understands the cybersecurity risk to organizational operations (including mission, functions, image, or reputation), organizational assets, and individuals.	**ID.RA-1:** Asset vulnerabilities are identified and documented	• **CCS CSC** 4 • **COBIT 5** APO12.01, APO12.02, APO12.03, APO12.04 • **ISA 62443-2-1:2009** 4.2.3, 4.2.3.7, 4.2.3.9, 4.2.3.12 • **ISO/IEC 27001:2013** A.12.6.1, A.18.2.3 • **NIST SP 800-53 Rev. 4** CA-2, CA-7, CA-8, RA-3, RA-5, SA-5, SA-11, SI-2, SI-4, SI-5
		ID.RA-2: Cyber threat intelligence ~~Threat and vulnerability information~~ and vulnerability information is received from information sharing forums and sources	• **ISA 62443-2-1:2009** 4.2.3, 4.2.3.9, 4.2.3.12 • **ISO/IEC 27001:2013** A.6.1.4 • **NIST SP 800-53 Rev. 4** PM-15, PM-16, SI-5
		ID.RA-3: Threats, both internal and external, are identified and documented	• **COBIT 5** APO12.01, APO12.02, APO12.03, APO12.04 • **ISA 62443-2-1:2009** 4.2.3, 4.2.3.9, 4.2.3.12 • **NIST SP 800-53 Rev. 4** RA-3, SI-5, PM-12, PM-16
		ID.RA-4: Potential business impacts and likelihoods are identified	• **COBIT 5** DSS04.02 • **ISA 62443-2-1:2009** 4.2.3, 4.2.3.9, 4.2.3.12 • **NIST SP 800-53 Rev. 4** RA-2, RA-3, PM-9, PM-11, SA-14
		ID.RA-5: Threats, vulnerabilities, likelihoods, and impacts are used to determine risk	• **COBIT 5** APO12.02 • **ISO/IEC 27001:2013** A.12.6.1 • **NIST SP 800-53 Rev. 4** RA-2, RA-3, PM-16

Function	Category	Subcategory	Informative References
		ID.RA-6: Risk responses are identified and prioritized	• **COBIT 5** APO12.05, APO13.02 • **NIST SP 800-53 Rev. 4** PM-4, PM-9
	Risk Management Strategy (ID.RM): The organization's priorities, constraints, risk tolerances, and assumptions are established and used to support operational risk decisions.	**ID.RM-1:** Risk management processes are established, managed, and agreed to by organizational stakeholders	• **COBIT 5** APO12.04, APO12.05, APO13.02, BAI02.03, BAI04.02 • **ISA 62443-2-1:2009** 4.3.4.2 • **NIST SP 800-53 Rev. 4** PM-9
		ID.RM-2: Organizational risk tolerance is determined and clearly expressed	• **COBIT 5** APO12.06 • **ISA 62443-2-1:2009** 4.3.2.6.5 • **NIST SP 800-53 Rev. 4** PM-9
		ID.RM-3: The organization's determination of risk tolerance is informed by its role in critical infrastructure and sector specific risk analysis	• **NIST SP 800-53 Rev. 4** PM-8, PM-9, PM-11, SA-14
	Supply Chain Risk Management (ID.SC): The organization's priorities, constraints, risk tolerances, and assumptions are established and used to support risk decisions associated with managing supply chain risk. The organization has in place the processes to identify, assess and manage supply chain risks.	**ID.SC-1:** Cyber supply chain risk management processes are identified, established, assessed, managed, and agreed to by organizational stakeholders	• **CIS CSC:** 4.8 • **COBIT 5:** APO10.01, APO10.04, APO12.04, APO12.05, APO13.02, BAI01.03, BAI02.03, BAI04.02 • **ISA 62443-2-1:2009**: 4.3.4.2 • **ISA 62443-3-3:2013:** • **ISO/IEC 27001:2013:** A.15.1.1, A.15.1.2, A.15.1.3, A.15.2.1, A.15.2.2 • **NIST SP 800-53:** SA-9, SA-12, PM-9
		ID.SC-2: Identify, prioritize and assess suppliers and partners of critical information systems, components and services using a cyber supply chain risk assessment process	• **CIS CSC:** • **COBIT 5:** APO10.01, APO10.02, APO10.04, APO10.05, APO12.01, APO12.02, APO12.03, APO12.04, APO12.05, APO12.06, APO13.02, BAI02.03 • **ISA 62443-2-1:2009:** 4.2.3.1, 4.2.3.2, 4.2.3.3,

Function	Category	Subcategory	Informative References
			4.2.3.4, 4.2.3.6, 4.2.3.8, 4.2.3.9, 4.2.3.10, 4.2.3.12, 4.2.3.13, 4.2.3.14 • **ISA 62443-3-3:2013:** • **ISO/IEC 27001:2013:** A.15.2.1, A.15.2.2 • **NIST SP 800-53**: RA-2, RA-3, SA-12, SA-14, SA-15, PM-9
		ID.SC-3: Suppliers and partners are required by contract to implement appropriate measures designed to meet the objectives of the Information Security program or Cyber Supply Chain Risk Management Plan.	• •**CIS CSC:** • **COBIT 5:** APO10.01, APO10.02, APO10.03, APO10.04, APO10.05 • **ISA 62443-2-1:2009:** 4.3.2.6.4, 4.3.2.6.7 • **ISA 62443-3-3:2013:** • **ISO/IEC 27001:2013:** A.15.1.1, A.15.1.2, A.15.1.3 • **NIST SP 800-53:** SA-9, SA-11, SA-12, PM-9
		ID.SC-4: Suppliers and partners are monitored to confirm that they have satisfied their obligations as required. Reviews of audits, summaries of test results, or other equivalent evaluations of suppliers/providers are conducted	• **CIS CSC:** • **COBIT 5:** APO10.01, APO10.03, APO10.04, APO10.05, MEA01.01, MEA01.02, MEA01.03, MEA01.04, MEA01.05 • **ISA 62443-2-1:2009:** 4.3.2.6.7 • **ISA 62443-3-3:2013:** SR 6.1 • **ISO/IEC 27001:2013:** A.15.2.1, A.15.2.2 • **NIST SP 800-53**: AU-2, AU-6, AU-12, AU-16, PS-7, SA-9, SA-12
		ID.SC-5: Response and recovery planning and testing are conducted with critical suppliers/providers	• **CIS CSC:** 19.7, 20.3 • **COBIT 5:** DSS04.04 • **ISA 62443-2-1:2009:** 4.3.2.5.7, 4.3.4.5.11 • **ISA 62443-3-3:2013:** SR 2.8, SR 3.3, SR.6.1, SR 7.3, SR 7.4 • **ISO/IEC 27001:2013** A.17.1.3 • **NIST SP 800-53**: CP-2, CP-4, IR-3, IR-4, IR-6, IR-8, IR-9

Function	Category	Subcategory	Informative References
PROTECT (PR)	**Identity Management, Authentication and Access Control (PR.AC):** Access to physical and logical assets and associated associated facilities is limited to authorized users, processes, or and devices, and is managed consistent with the assessed risk of unauthorized access to authorized activities and transactions.	**PR.AC-1:** Identities and credentials are issued, managed, verified, revoked, and auditedmanaged for authorized devices, and users, and processes	• **CCS CSC** 16 • **COBIT 5** DSS05.04, DSS06.03 • **ISA 62443-2-1:2009** 4.3.3.5.1 • **ISA 62443-3-3:2013** SR 1.1, SR 1.2, SR 1.3, SR 1.4, SR 1.5, SR 1.7, SR 1.8, SR 1.9 • **ISO/IEC 27001:2013** A.9.2.1, A.9.2.2, A.9.2.4, A.9.3.1, A.9.4.2, A.9.4.3 • **NIST SP 800-53 Rev. 4** AC-2, IA Family
		PR.AC-2: Physical access to assets is managed and protected	• **COBIT 5** DSS01.04, DSS05.05 • **ISA 62443-2-1:2009** 4.3.3.3.2, 4.3.3.3.8 • **ISO/IEC 27001:2013** A.11.1.1, A.11.1.2, A.11.1.4, A.11.1.6, A.11.2.3 • **NIST SP 800-53 Rev. 4** PE-2, PE-3, PE-4, PE-5, PE-6, PE-9
		PR.AC-3: Remote access is managed	• **COBIT 5** APO13.01, DSS01.04, DSS05.03 • **ISA 62443-2-1:2009** 4.3.3.6.6 • **ISA 62443-3-3:2013** SR 1.13, SR 2.6 • **ISO/IEC 27001:2013** A.6.2.2, A.13.1.1, A.13.2.1 • **NIST SP 800-53 Rev. 4** AC-17, AC-19, AC-20
		PR.AC-4: Access permissions and authorizations are managed, incorporating the principles of least privilege and separation of duties	• **CCS CSC** 12, 15 • **ISA 62443-2-1:2009** 4.3.3.7.3 • **ISA 62443-3-3:2013** SR 2.1 • **ISO/IEC 27001:2013** A.6.1.2, A.9.1.2, A.9.2.3, A.9.4.1, A.9.4.4 • **NIST SP 800-53 Rev. 4** AC-2, AC-3, AC-5, AC-6, AC-16
		PR.AC-5: Network integrity is protected, incorporating network segregation where appropriate	• **ISA 62443-2-1:2009** 4.3.3.4 • **ISA 62443-3-3:2013** SR 3.1, SR 3.8 • **ISO/IEC 27001:2013** A.13.1.1, A.13.1.3, A.13.2.1

Function	Category	Subcategory	Informative References
			• **NIST SP 800-53 Rev. 4** AC-4, SC-7
		PR.AC-6: Identities are proofed and bound to credentials, and asserted in interactions when appropriate	• **CIS CSC: CSC 5, 12, 14, 16** • **COBIT 5: DSS05.04, DSS05.05, DSS05.07, DSS06.03, BAI08.03** • **ISA 62443-2-1:2009: 4.3.2.4.2, 4.3.3.2.2, 4.3.3.2.3, 4.3.3.5.2, 4.3.3.7.1, 4.3.3.7.2, 4.3.3.7.3, 4.3.3.7.4** • **ISA 62443-3-3:2013: SR 1.4, SR 1.5, SR 2.1, SR 2.2, SR 2.3** • **ISO/IEC 27001:2013: A.6.1.2, A.7.1.1, A.9.1.2, A.9.2.2, A.9.2.3, A.9.2.5, A.9.2.6, A.9.4.1, A.9.4.4** • **NIST SP 800-53: AC-2, AC-3, AC-5, AC-6, AC-16, AC-19, AC-24, IA-2, IA-4, IA-5, IA-8, PE-2, PS-3**
	Awareness and Training (PR.AT): The organization's personnel and partners are provided cybersecurity awareness education and are adequately trained to perform their information security-related duties and responsibilities consistent with related policies, procedures, and agreements.	**PR.AT-1:** All users are informed and trained	• **CCS CSC** 9 • **COBIT 5** APO07.03, BAI05.07 • **ISA 62443-2-1:2009** 4.3.2.4.2 • **ISO/IEC 27001:2013** A.7.2.2 • **NIST SP 800-53 Rev. 4** AT-2, PM-13
		PR.AT-2: Privileged users understand roles & responsibilities	• **CCS CSC** 9 • **COBIT 5** APO07.02, DSS06.03 • **ISA 62443-2-1:2009** 4.3.2.4.2, 4.3.2.4.3 • **ISO/IEC 27001:2013** A.6.1.1, A.7.2.2 • **NIST SP 800-53 Rev. 4** AT-3, PM-13
		PR.AT-3: Third-party stakeholders (e.g., suppliers, customers, partners) understand roles & responsibilities	• **CCS CSC** 9 • **COBIT 5** APO07.03, APO10.04, APO10.05 • **ISA 62443-2-1:2009** 4.3.2.4.2 • **ISO/IEC 27001:2013** A.6.1.1, A.7.2.2 • **NIST SP 800-53 Rev. 4** PS-7, SA-9
		PR.AT-4: Senior executives understand roles & responsibilities	• **CCS CSC** 9 • **COBIT 5** APO07.03

Function	Category	Subcategory	Informative References
			• **ISA 62443-2-1:2009** 4.3.2.4.2 • **ISO/IEC 27001:2013** A.6.1.1, A.7.2.2, • **NIST SP 800-53 Rev. 4** AT-3, PM-13
		PR.AT-5: Physical and information security personnel understand roles & responsibilities	• **CCS CSC** 9 • **COBIT 5** APO07.03 • **ISA 62443-2-1:2009** 4.3.2.4.2 • **ISO/IEC 27001:2013** A.6.1.1, A.7.2.2, • **NIST SP 800-53 Rev. 4** AT-3, PM-13
	Data Security (PR.DS): Information and records (data) are managed consistent with the organization's risk strategy to protect the confidentiality, integrity, and availability of information.	**PR.DS-1:** Data-at-rest is protected	• **CCS CSC** 17 • **COBIT 5** APO01.06, BAI02.01, BAI06.01, DSS06.06 • **ISA 62443-3-3:2013** SR 3.4, SR 4.1 • **ISO/IEC 27001:2013** A.8.2.3 • **NIST SP 800-53 Rev. 4** SC-28
		PR.DS-2: Data-in-transit is protected	• **CCS CSC** 17 • **COBIT 5** APO01.06, DSS06.06 • **ISA 62443-3-3:2013** SR 3.1, SR 3.8, SR 4.1, SR 4.2 • **ISO/IEC 27001:2013** A.8.2.3, A.13.1.1, A.13.2.1, A.13.2.3, A.14.1.2, A.14.1.3 • **NIST SP 800-53 Rev. 4** SC-8
		PR.DS-3: Assets are formally managed throughout removal, transfers, and disposition	• **COBIT 5** BAI09.03 • **ISA 62443-2-1:2009** 4. 4.3.3.3.9, 4.3.4.4.1 • **ISA 62443-3-3:2013** SR 4.2 • **ISO/IEC 27001:2013** A.8.2.3, A.8.3.1, A.8.3.2, A.8.3.3, A.11.2.7 • **NIST SP 800-53 Rev. 4** CM-8, MP-6, PE-16
		PR.DS-4: Adequate capacity to ensure availability is maintained	• **COBIT 5** APO13.01 • **ISA 62443-3-3:2013** SR 7.1, SR 7.2 • **ISO/IEC 27001:2013** A.12.3.1

Function	Category	Subcategory	Informative References
			• **NIST SP 800-53 Rev. 4** AU-4, CP-2, SC-5
		PR.DS-5: Protections against data leaks are implemented	• **CCS CSC** 17 • **COBIT 5** APO01.06 • **ISA 62443-3-3:2013** SR 5.2 • **ISO/IEC 27001:2013** A.6.1.2, A.7.1.1, A.7.1.2, A.7.3.1, A.8.2.2, A.8.2.3, A.9.1.1, A.9.1.2, A.9.2.3, A.9.4.1, A.9.4.4, A.9.4.5, A.13.1.3, A.13.2.1, A.13.2.3, A.13.2.4, A.14.1.2, A.14.1.3 • **NIST SP 800-53 Rev. 4** AC-4, AC-5, AC-6, PE-19, PS-3, PS-6, SC-7, SC-8, SC-13, SC-31, SI-4
		PR.DS-6: Integrity checking mechanisms are used to verify software, firmware, and information integrity	• **ISA 62443-3-3:2013** SR 3.1, SR 3.3, SR 3.4, SR 3.8 • **ISO/IEC 27001:2013** A.12.2.1, A.12.5.1, A.14.1.2, A.14.1.3 • **NIST SP 800-53 Rev. 4** SI-7
		PR.DS-7: The development and testing environment(s) are separate from the production environment	• **COBIT 5** BAI07.04 • **ISO/IEC 27001:2013** A.12.1.4 • **NIST SP 800-53 Rev. 4** CM-2
		PR.DS-8: Integrity checking mechanisms are used to verify hardware integrity	• **CIS CSC: CSC 3.3** • **COBIT 5: BAI03.05.4** • **ISA 62443-2-1:2009: 4.3.4.4.4** • **ISA 62443-3-3:2013:** • **ISO/IEC 27001:2013: A.11.2.4** • **NIST SP 800-53: SA-10, SI-7**
	Information Protection Processes and Procedures (PR.IP): Security policies (that address purpose, scope, roles, responsibilities, management commitment, and coordination among organizational entities), processes, and procedures are	**PR.IP-1:** A baseline configuration of information technology/industrial control systems is created and maintained incorporating appropriate security principles (e.g. concept of least functionality, separation of duties)	• **CCS CSC** 3, 10 • **COBIT 5** BAI10.01, BAI10.02, BAI10.03, BAI10.05 • **ISA 62443-2-1:2009** 4.3.4.3.2, 4.3.4.3.3 • **ISA 62443-3-3:2013** SR 7.6 • **ISO/IEC 27001:2013** A.12.1.2, A.12.5.1, A.12.6.2, A.14.2.2, A.14.2.3, A.14.2.4

Function	Category	Subcategory	Informative References
	maintained and used to manage protection of information systems and assets.		• **NIST SP 800-53 Rev. 4** CM-2, CM-3, CM-4, CM-5, CM-6, CM-7, CM-9, SA-10
		PR.IP-2: A System Development Life Cycle to manage systems is implemented	• **COBIT 5** APO13.01 • **ISA 62443-2-1:2009** 4.3.4.3.3 • **ISO/IEC 27001:2013** A.6.1.5, A.14.1.1, A.14.2.1, A.14.2.5 • **NIST SP 800-53 Rev. 4** SA-3, SA-4, SA-8, SA-10, SA-11, SA-12, SA-15, SA-17, PL-8
		PR.IP-3: Configuration change control processes are in place	• **COBIT 5** BAI06.01, BAI01.06 • **ISA 62443-2-1:2009** 4.3.4.3.2, 4.3.4.3.3 • **ISA 62443-3-3:2013** SR 7.6 • **ISO/IEC 27001:2013** A.12.1.2, A.12.5.1, A.12.6.2, A.14.2.2, A.14.2.3, A.14.2.4 • **NIST SP 800-53 Rev. 4** CM-3, CM-4, SA-10
		PR.IP-4: Backups of information are conducted, maintained, and tested periodically	• **COBIT 5** APO13.01 • **ISA 62443-2-1:2009** 4.3.4.3.9 • **ISA 62443-3-3:2013** SR 7.3, SR 7.4 • **ISO/IEC 27001:2013** A.12.3.1, A.17.1.2A.17.1.3, A.18.1.3 • **NIST SP 800-53 Rev. 4** CP-4, CP-6, CP-9
		PR.IP-5: Policy and regulations regarding the physical operating environment for organizational assets are met	• **COBIT 5** DSS01.04, DSS05.05 • **ISA 62443-2-1:2009** 4.3.3.3.1 4.3.3.3.2, 4.3.3.3.3, 4.3.3.3.5, 4.3.3.3.6 • **ISO/IEC 27001:2013** A.11.1.4, A.11.2.1, A.11.2.2, A.11.2.3 • **NIST SP 800-53 Rev. 4** PE-10, PE-12, PE-13, PE-14, PE-15, PE-18
		PR.IP-6: Data is destroyed according to policy	• **COBIT 5** BAI09.03 • **ISA 62443-2-1:2009** 4.3.4.4.4 • **ISA 62443-3-3:2013** SR 4.2 • **ISO/IEC 27001:2013** A.8.2.3, A.8.3.1, A.8.3.2,

Function	Category	Subcategory	Informative References
			A.11.2.7 • **NIST SP 800-53 Rev. 4** MP-6
		PR.IP-7: Protection processes are continuously improved	• **COBIT 5** APO11.06, DSS04.05 • **ISA 62443-2-1:2009** 4.4.3.1, 4.4.3.2, 4.4.3.3, 4.4.3.4, 4.4.3.5, 4.4.3.6, 4.4.3.7, 4.4.3.8 • **NIST SP 800-53 Rev. 4** CA-2, CA-7, CP-2, IR-8, PL-2, PM-6
		PR.IP-8: Effectiveness of protection technologies is shared with appropriate parties	• **ISO/IEC 27001:2013** A.16.1.6 • **NIST SP 800-53 Rev. 4** AC-21, CA-7, SI-4
		PR.IP-9: Response plans (Incident Response and Business Continuity) and recovery plans (Incident Recovery and Disaster Recovery) are in place and managed	• **COBIT 5** DSS04.03 • **ISA 62443-2-1:2009** 4.3.2.5.3, 4.3.4.5.1 • **ISO/IEC 27001:2013** A.16.1.1, A.17.1.1, A.17.1.2 • **NIST SP 800-53 Rev. 4** CP-2, IR-8
		PR.IP-10: Response and recovery plans are tested	• **ISA 62443-2-1:2009** 4.3.2.5.7, 4.3.4.5.11 • **ISA 62443-3-3:2013** SR 3.3 • **ISO/IEC 27001:2013** A.17.1.3 • **NIST SP 800-53 Rev. 4** CP-4, IR-3, PM-14
		PR.IP-11: Cybersecurity is included in human resources practices (e.g., deprovisioning, personnel screening)	• **COBIT 5** APO07.01, APO07.02, APO07.03, APO07.04, APO07.05 • **ISA 62443-2-1:2009** 4.3.3.2.1, 4.3.3.2.2, 4.3.3.2.3 • **ISO/IEC 27001:2013** A.7.1.1, A.7.3.1, A.8.1.4 • **NIST SP 800-53 Rev. 4** PS Family
		PR.IP-12: A vulnerability management plan is developed and implemented	• **ISO/IEC 27001:2013** A.12.6.1, A.18.2.2 • **NIST SP 800-53 Rev. 4** RA-3, RA-5, SI-2
	Maintenance (PR.MA): Maintenance and repairs of industrial control and information system components is performed	**PR.MA-1:** Maintenance and repair of organizational assets is performed and logged in a timely manner, with approved and controlled tools	• **COBIT 5** BAI09.03 • **ISA 62443-2-1:2009** 4.3.3.3.7 • **ISO/IEC 27001:2013** A.11.1.2, A.11.2.4, A.11.2.5

Function	Category	Subcategory	Informative References
	consistent with policies and procedures.		• **NIST SP 800-53 Rev. 4** MA-2, MA-3, MA-5
		PR.MA-2: Remote maintenance of organizational assets is approved, logged, and performed in a manner that prevents unauthorized access	• **COBIT 5** DSS05.04 • **ISA 62443-2-1:2009** 4.3.3.6.5, 4.3.3.6.6, 4.3.3.6.7, 4.4.4.6.8 • **ISO/IEC 27001:2013** A.11.2.4, A.15.1.1, A.15.2.1 • **NIST SP 800-53 Rev. 4** MA-4
	Protective Technology (PR.PT): Technical security solutions are managed to ensure the security and resilience of systems and assets, consistent with related policies, procedures, and agreements.	**PR.PT-1:** Audit/log records are determined, documented, implemented, and reviewed in accordance with policy	• **CCS CSC** 14 • **COBIT 5** APO11.04 • **ISA 62443-2-1:2009** 4.3.3.3.9, 4.3.3.5.8, 4.3.4.4.7, 4.4.2.1, 4.4.2.2, 4.4.2.4 • **ISA 62443-3-3:2013** SR 2.8, SR 2.9, SR 2.10, SR 2.11, SR 2.12 • **ISO/IEC 27001:2013** A.12.4.1, A.12.4.2, A.12.4.3, A.12.4.4, A.12.7.1 • **NIST SP 800-53 Rev. 4** AU Family
		PR.PT-2: Removable media is protected and its use restricted according to policy	• **COBIT 5** DSS05.02, APO13.01 • **ISA 62443-3-3:2013** SR 2.3 • **ISO/IEC 27001:2013** A.8.2.2, A.8.2.3, A.8.3.1, A.8.3.3, A.11.2.9 • **NIST SP 800-53 Rev. 4** MP-2, MP-4, MP-5, MP-7
		PR.PT-3: ~~Access to systems and assets is controlled, incorporating the principle of least functionality~~ The principle of least functionality is incorporated by configuring systems to provide only essential capabilities	• **COBIT 5** DSS05.02 • **ISA 62443-2-1:2009** 4.3.3.5.1, 4.3.3.5.2, 4.3.3.5.3, 4.3.3.5.4, 4.3.3.5.5, 4.3.3.5.6, 4.3.3.5.7, 4.3.3.5.8, 4.3.3.6.1, 4.3.3.6.2, 4.3.3.6.3, 4.3.3.6.4, 4.3.3.6.5, 4.3.3.6.6, 4.3.3.6.7, 4.3.3.6.8, 4.3.3.6.9, 4.3.3.7.1, 4.3.3.7.2, 4.3.3.7.3, 4.3.3.7.4 • **ISA 62443-3-3:2013** SR 1.1, SR 1.2, SR 1.3,

Function	Category	Subcategory	Informative References
			SR 1.4, SR 1.5, SR 1.6, SR 1.7, SR 1.8, SR 1.9, SR 1.10, SR 1.11, SR 1.12, SR 1.13, SR 2.1, SR 2.2, SR 2.3, SR 2.4, SR 2.5, SR 2.6, SR 2.7 • **ISO/IEC 27001:2013** A.9.1.2 • **NIST SP 800-53 Rev. 4** AC-3, CM-7
		PR.PT-4: Communications and control networks are protected	• **CCS CSC** 7 • **COBIT 5** DSS05.02, APO13.01 • **ISA 62443-3-3:2013** SR 3.1, SR 3.5, SR 3.8, SR 4.1, SR 4.3, SR 5.1, SR 5.2, SR 5.3, SR 7.1, SR 7.6 • **ISO/IEC 27001:2013** A.13.1.1, A.13.2.1 • **NIST SP 800-53 Rev. 4** AC-4, AC-17, AC-18, CP-8, SC-7
		PR.PT-5: Systems operate in pre-defined functional states to achieve availability (e.g. under duress, under attack, during recovery, normal operations).	• **CIS CSC:** • **COBIT 5: BAI04.01, BAI04.02, BAI04.03, BAI04.04, BAI04.05, DSS01.05** • **ISA 62443-2-1:2009: 4.3.2.5.2** • **ISA 62443-3-3:2013: SR 7.1, SR 7.2** • **ISO/IEC 27001:2013: A.17.1.2, A.17.2.1** • **NIST SP 800-53: CP-7, CP-8, CP-11, CP-13, PL-8, SA-14, SC-6**
DETECT (DE)	**Anomalies and Events (DE.AE):** Anomalous activity is detected in a timely manner and the potential impact of events is understood.	**DE.AE-1:** A baseline of network operations and expected data flows for users and systems is established and managed	• **COBIT 5** DSS03.01 • **ISA 62443-2-1:2009** 4.4.3.3 • **NIST SP 800-53 Rev. 4** AC-4, CA-3, CM-2, SI-4
		DE.AE-2: Detected events are analyzed to understand attack targets and methods	• **ISA 62443-2-1:2009** 4.3.4.5.6, 4.3.4.5.7, 4.3.4.5.8 • **ISA 62443-3-3:2013** SR 2.8, SR 2.9, SR 2.10, SR 2.11, SR 2.12, SR 3.9, SR 6.1, SR 6.2 • **ISO/IEC 27001:2013** A.16.1.1, A.16.1.4 • **NIST SP 800-53 Rev. 4** AU-6, CA-7, IR-4, SI-4
		DE.AE-3: Event data are aggregated and	• **ISA 62443-3-3:2013** SR 6.1

Function	Category	Subcategory	Informative References
		correlated from multiple sources and sensors	• **NIST SP 800-53 Rev. 4** AU-6, CA-7, IR-4, IR-5, IR-8, SI-4
		DE.AE-4: Impact of events is determined	• **COBIT 5** APO12.06 • **NIST SP 800-53 Rev. 4** CP-2, IR-4, RA-3, SI - 4
		DE.AE-5: Incident alert thresholds are established	• **COBIT 5** APO12.06 • **ISA 62443-2-1:2009** 4.2.3.10 • **NIST SP 800-53 Rev. 4** IR-4, IR-5, IR-8
	Security Continuous Monitoring (DE.CM): The information system and assets are monitored at discrete intervals to identify cybersecurity events and verify the effectiveness of protective measures.	**DE.CM-1:** The network is monitored to detect potential cybersecurity events	• **CCS CSC** 14, 16 • **COBIT 5** DSS05.07 • **ISA 62443-3-3:2013** SR 6.2 • **NIST SP 800-53 Rev. 4** AC-2, AU-12, CA-7, CM-3, SC-5, SC-7, SI-4
		DE.CM-2: The physical environment is monitored to detect potential cybersecurity events	• **ISA 62443-2-1:2009** 4.3.3.3.8 • **NIST SP 800-53 Rev. 4** CA-7, PE-3, PE-6, PE-20
		DE.CM-3: Personnel activity is monitored to detect potential cybersecurity events	• **ISA 62443-3-3:2013** SR 6.2 • **ISO/IEC 27001:2013** A.12.4.1 • **NIST SP 800-53 Rev. 4** AC-2, AU-12, AU-13, CA-7, CM-10, CM-11
		DE.CM-4: Malicious code is detected	• **CCS CSC** 5 • **COBIT 5** DSS05.01 • **ISA 62443-2-1:2009** 4.3.4.3.8 • **ISA 62443-3-3:2013** SR 3.2 • **ISO/IEC 27001:2013** A.12.2.1 • **NIST SP 800-53 Rev. 4** SI-3
		DE.CM-5: Unauthorized mobile code is detected	• **ISA 62443-3-3:2013** SR 2.4 • **ISO/IEC 27001:2013** A.12.5.1 • **NIST SP 800-53 Rev. 4** SC-18, SI-4. SC-44

Function	Category	Subcategory	Informative References
		DE.CM-6: External service provider activity is monitored to detect potential cybersecurity events	• **COBIT 5** APO07.06 • **ISO/IEC 27001:2013** A.14.2.7, A.15.2.1 • **NIST SP 800-53 Rev. 4** CA-7, PS-7, SA-4, SA-9, SI-4
		DE.CM-7: Monitoring for unauthorized personnel, connections, devices, and software is performed	• **NIST SP 800-53 Rev. 4** AU-12, CA-7, CM-3, CM-8, PE-3, PE-6, PE-20, SI-4
		DE.CM-8: Vulnerability scans are performed	• **COBIT 5** BAI03.10 • **ISA 62443-2-1:2009** 4.2.3.1, 4.2.3.7 • **ISO/IEC 27001:2013** A.12.6.1 • **NIST SP 800-53 Rev. 4** RA-5
	Detection Processes (DE.DP): Detection processes and procedures are maintained and tested to ensure timely and adequate awareness of anomalous events.	**DE.DP-1:** Roles and responsibilities for detection are well defined to ensure accountability	• **CCS CSC** 5 • **COBIT 5** DSS05.01 • **ISA 62443-2-1:2009** 4.4.3.1 • **ISO/IEC 27001:2013** A.6.1.1 • **NIST SP 800-53 Rev. 4** CA-2, CA-7, PM-14
		DE.DP-2: Detection activities comply with all applicable requirements	• **ISA 62443-2-1:2009** 4.4.3.2 • **ISO/IEC 27001:2013** A.18.1.4 • **NIST SP 800-53 Rev. 4** CA-2, CA-7, PM-14, SI-4
		DE.DP-3: Detection processes are tested	• **COBIT 5** APO13.02 • **ISA 62443-2-1:2009** 4.4.3.2 • **ISA 62443-3-3:2013** SR 3.3 • **ISO/IEC 27001:2013** A.14.2.8 • **NIST SP 800-53 Rev. 4** CA-2, CA-7, PE-3, PM-14, SI-3, SI-4
		DE.DP-4: Event detection information is communicated to appropriate parties	• **COBIT 5** APO12.06 • **ISA 62443-2-1:2009** 4.3.4.5.9 • **ISA 62443-3-3:2013** SR 6.1 • **ISO/IEC 27001:2013** A.16.1.2 • **NIST SP 800-53 Rev. 4** AU-6, CA-2, CA-7,

Function	Category	Subcategory	Informative References
			RA-5, SI-4
		DE.DP-5: Detection processes are continuously improved	• **COBIT 5** APO11.06, DSS04.05 • **ISA 62443-2-1:2009** 4.4.3.4 • **ISO/IEC 27001:2013** A.16.1.6 • **NIST SP 800-53 Rev. 4**, CA-2, CA-7, PL-2, RA-5, SI-4, PM-14

Function	Category	Subcategory	Informative References
RESPOND (RS)	**Response Planning (RS.RP):** Response processes and procedures are executed and maintained, to ensure timely response to detected cybersecurity events.	**RS.RP-1:** Response plan is executed during or after an event	• **COBIT 5** BAI01.10 • **CCS CSC** 18 • **ISA 62443-2-1:2009** 4.3.4.5.1 • **ISO/IEC 27001:2013** A.16.1.5 • **NIST SP 800-53 Rev. 4** CP-2, CP-10, IR-4, IR-8
	Communications (RS.CO): Response activities are coordinated with internal and external stakeholders, as appropriate, to include external support from law enforcement agencies.	**RS.CO-1:** Personnel know their roles and order of operations when a response is needed	• **ISA 62443-2-1:2009** 4.3.4.5.2, 4.3.4.5.3, 4.3.4.5.4 • **ISO/IEC 27001:2013** A.6.1.1, A.16.1.1 **NIST SP 800-53 Rev. 4** CP-2, CP-3, IR-3, IR-8
		RS.CO-2: Events are reported consistent with established criteria	• **ISA 62443-2-1:2009** 4.3.4.5.5 • **ISO/IEC 27001:2013** A.6.1.3, A.16.1.2 • **NIST SP 800-53 Rev. 4** AU-6, IR-6, IR-8
		RS.CO-3: Information is shared consistent with response plans	• **ISA 62443-2-1:2009** 4.3.4.5.2 • **ISO/IEC 27001:2013** A.16.1.2 • **NIST SP 800-53 Rev. 4** CA-2, CA-7, CP-2, IR-4, IR-8, PE-6, RA-5, SI-4
		RS.CO-4: Coordination with stakeholders occurs consistent with response plans	• **ISA 62443-2-1:2009** 4.3.4.5.5 • **NIST SP 800-53 Rev. 4** CP-2, IR-4, IR-8
		RS.CO-5: Voluntary information sharing occurs with external stakeholders to achieve broader cybersecurity situational awareness	• **NIST SP 800-53 Rev. 4** PM-15, SI-5
	Analysis (RS.AN): Analysis is conducted to ensure adequate response and support recovery activities.	**RS.AN-1:** Notifications from detection systems are investigated	• **COBIT 5** DSS02.07 • **ISA 62443-2-1:2009** 4.3.4.5.6, 4.3.4.5.7, 4.3.4.5.8 • **ISA 62443-3-3:2013** SR 6.1 • **ISO/IEC 27001:2013** A.12.4.1, A.12.4.3, A.16.1.5 • **NIST SP 800-53 Rev. 4** AU-6, CA-7, IR-4, IR-5, PE-6, SI-4

Function	Category	Subcategory	Informative References
		RS.AN-2: The impact of the incident is understood	• **ISA 62443-2-1:2009** 4.3.4.5.6, 4.3.4.5.7, 4.3.4.5.8 • **ISO/IEC 27001:2013** A.16.1.6 • **NIST SP 800-53 Rev. 4** CP-2, IR-4
		RS.AN-3: Forensics are performed	• **ISA 62443-3-3:2013** SR 2.8, SR 2.9, SR 2.10, SR 2.11, SR 2.12, SR 3.9, SR 6.1 • **ISO/IEC 27001:2013** A.16.1.7 • **NIST SP 800-53 Rev. 4** AU-7, IR-4
		RS.AN-4: Incidents are categorized consistent with response plans	• **ISA 62443-2-1:2009** 4.3.4.5.6 • **ISO/IEC 27001:2013** A.16.1.4 • **NIST SP 800-53 Rev. 4** CP-2, IR-4, IR-5, IR-8
	Mitigation (RS.MI): Activities are performed to prevent expansion of an event, mitigate its effects, and eradicate the incident.	**RS.MI-1:** Incidents are contained	• **ISA 62443-2-1:2009** 4.3.4.5.6 • **ISA 62443-3-3:2013** SR 5.1, SR 5.2, SR 5.4 • **ISO/IEC 27001:2013** A.16.1.5 • **NIST SP 800-53 Rev. 4** IR-4
		RS.MI-2: Incidents are mitigated	• **ISA 62443-2-1:2009** 4.3.4.5.6, 4.3.4.5.10 • **ISO/IEC 27001:2013** A.12.2.1, A.16.1.5 • **NIST SP 800-53 Rev. 4** IR-4
		RS.MI-3: Newly identified vulnerabilities are mitigated or documented as accepted risks	• **ISO/IEC 27001:2013** A.12.6.1 • **NIST SP 800-53 Rev. 4** CA-7, RA-3, RA-5
	Improvements (RS.IM): Organizational response activities are improved by incorporating lessons learned from current and previous detection/response activities.	**RS.IM-1:** Response plans incorporate lessons learned	• **COBIT 5** BAI01.13 • **ISA 62443-2-1:2009** 4.3.4.5.10, 4.4.3.4 • **ISO/IEC 27001:2013** A.16.1.6 • **NIST SP 800-53 Rev. 4** CP-2, IR-4, IR-8
		RS.IM-2: Response strategies are updated	• **NIST SP 800-53 Rev. 4** CP-2, IR-4, IR-8
RECOVER (RC)	**Recovery Planning (RC.RP):** Recovery processes and procedures are executed and maintained to ensure timely restoration of systems or assets	**RC.RP-1:** Recovery plan is executed during or after an event	• **CCS CSC** 8 • **COBIT 5** DSS02.05, DSS03.04 • **ISO/IEC 27001:2013** A.16.1.5 • **NIST SP 800-53 Rev. 4** CP-10, IR-4, IR-8

Function	Category	Subcategory	Informative References
	affected by cybersecurity events.		
	Improvements (RC.IM): Recovery planning and processes are improved by incorporating lessons learned into future activities.	**RC.IM-1:** Recovery plans incorporate lessons learned	• **COBIT 5** BAI05.07 • **ISA 62443-2-1:2009** 4.4.3.4 • **NIST SP 800-53 Rev. 4** CP-2, IR-4, IR-8
		RC.IM-2: Recovery strategies are updated	• **COBIT 5** BAI07.08 • **NIST SP 800-53 Rev. 4** CP-2, IR-4, IR-8
	Communications (RC.CO): Restoration activities are coordinated with internal and external parties, such as coordinating centers, Internet Service Providers, owners of attacking systems, victims, other CSIRTs, and vendors.	**RC.CO-1:** Public relations are managed	• **COBIT 5** EDM03.02
		RC.CO-2: Reputation after an event is repaired	• **COBIT 5** MEA03.02
		RC.CO-3: Recovery activities are communicated to internal stakeholders and executive and management teams	• **NIST SP 800-53 Rev. 4** CP-2, IR-4

896   Information regarding Informative References described in Appendix A may be found at the following locations:

897   •   Control Objectives for Information and Related Technology (COBIT): http://www.isaca.org/COBIT/Pages/default.aspx

898   •   ~~Council on CyberSecurity (CCS) Top 20 Critical Security Controls (CSC): http://www.counciloncybersecurity.org~~

899   •   Center for Internet Security (CIS) Critical Security Controls for Effective Cyber Defense (CSC): https://www.cisecurity.org

900   •   ANSI/ISA-62443-2-1 (99.02.01)-2009, *Security for Industrial Automation and Control Systems: Establishing an Industrial*
901   *Automation and Control Systems Security Program*: https://www.isa.org/templates/one-
902   column.aspx?pageid=111294&productId=116731~~http://www.isa.org/Template.cfm?Section=Standards8&Template=/Ecomme~~
903   ~~rce/ProductDisplay.cfm&ProductID=10243~~

904   •   ANSI/ISA-62443-3-3 (99.03.03)-2013, *Security for Industrial Automation and Control Systems: System Security Requirements*
905   *and Security Levels*: https://www.isa.org/templates/one-
906   column.aspx?pageid=111294&productId=116785~~http://www.isa.org/Template.cfm?Section=Standards2&template=/Ecommer~~
907   ~~ce/ProductDisplay.cfm&ProductID=13420~~

908   •   ISO/IEC 27001, *Information technology -- Security techniques -- Information security management systems -- Requirements*:
909   http://www.iso.org/iso/home/store/catalogue_ics/catalogue_detail_ics.htm?csnumber=54534

910   • NIST SP 800-53 Rev. 4: NIST Special Publication 800-53 Revision 4, *Security and Privacy Controls for Federal Information*
911   *Systems and Organizations*, April 2013 (including updates as of January 15, 2014). http://dx.doi.org/10.6028/NIST.SP.800-
912   53r4.

913   Mappings between the Framework Core Subcategories and the specified sections in the Informative References represent a general
914   correspondence and are not intended to definitively determine whether the specified sections in the Informative References provide
915   the desired Subcategory outcome.

916   ## Appendix B: Glossary

917   This appendix defines selected terms used in the publication.

Buyer	The people or organizations that consume a given product or service
Category	The subdivision of a Function into groups of cybersecurity outcomes, closely tied to programmatic needs and particular activities. Examples of Categories include "Asset Management," "Access Control," and "Detection Processes."
Critical Infrastructure	Systems and assets, whether physical or virtual, so vital to the United States that the incapacity or destruction of such systems and assets would have a debilitating impact on cybersecurity, national economic security, national public health or safety, or any combination of those matters.
Cybersecurity	The process of protecting information by preventing, detecting, and responding to attacks.
Cybersecurity Event	A cybersecurity change that may have an impact on organizational operations (including mission, capabilities, or reputation).
Detect (function)	Develop and implement the appropriate activities to identify the occurrence of a cybersecurity event.
Framework	A risk-based approach to reducing cybersecurity risk composed of three parts: the Framework Core, the Framework Profile, and the Framework Implementation Tiers. Also known as the "Cybersecurity Framework."
Framework Core	A set of cybersecurity activities and references that are common across critical infrastructure sectors and are organized around particular outcomes. The Framework Core comprises four types of elements: Functions, Categories, Subcategories, and Informative References.
Framework Implementation Tier	A lens through which to view the characteristics of an organization's approach to risk—how an organization views cybersecurity risk and the processes in place to manage that risk.
Framework Profile	A representation of the outcomes that a particular system or organization has selected from the Framework Categories and Subcategories.
Function	One of the main components of the Framework. Functions provide the highest level of structure for organizing basic cybersecurity activities into Categories and Subcategories. The five functions are Identify,

Protect, Detect, Respond, and Recover.

Identify (function) — Develop the organizational understanding to manage cybersecurity risk to systems, assets, data, and capabilities.

Informative Reference — A specific section of standards, guidelines, and practices common among critical infrastructure sectors that illustrates a method to achieve the outcomes associated with each Subcategory. An example of an Informative Reference is ISO/IEC 27001 Control A.10.8.3, which supports the "Data-in-transit is protected" Subcategory of the "Data Security" Category in the "Protect" function.

Lagging Measurement — A measurement of whether an outcome was fulfilled or not. Since this measure is taken after an outcome is achieved, it cannot be used to guide fulfillment of that outcome.

Leading Measurement — A predictive measurement of whether an outcome is likely or not to be achieve. It may guide future activities to ensure a specific outcome is achieved.

Measures — Quantifiable, observable, objective data supporting Metrics. Typically, Measures align with technical controls, such as the Informative References.

Metrics — Used to facilitate decision making and improve performance and accountability. Typically, Metrics are higher level, qualitative, and an aggregate of several Measures.

Mobile Code — A program (e.g., script, macro, or other portable instruction) that can be shipped unchanged to a heterogeneous collection of platforms and executed with identical semantics.

Non-IT/OT Partner — Product or service providers that do not provide IT or OT to a given organization, but who do affect the security of that organization

Protect (function) — Develop and implement the appropriate safeguards to ensure delivery of critical infrastructure services.

Privileged User — A user that is authorized (and, therefore, trusted) to perform security-relevant functions that ordinary users are not authorized to perform.

Recover (function) — Develop and implement the appropriate activities to maintain plans for resilience and to restore any capabilities or services that were impaired due to a cybersecurity event.

Respond (function) — Develop and implement the appropriate activities to take action regarding a detected cybersecurity event.

Risk — A measure of the extent to which an entity is threatened by a potential circumstance or event, and typically a function of: (i) the adverse

impacts that would arise if the circumstance or event occurs; and (ii) the likelihood of occurrence.

Risk Management   The process of identifying, assessing, and responding to risk.

Subcategory   The subdivision of a Category into specific outcomes of technical and/or management activities. Examples of Subcategories include "External information systems are catalogued," "Data-at-rest is protected," and "Notifications from detection systems are investigated."

Supplier   Product and service providers used for an organization's internal purposes (e.g., IT infrastructure) or integrated into the products of services provided to that organization's Buyers

918   ## Appendix C: Acronyms

919   This appendix defines selected acronyms used in the publication.

920   **CCS**   Council on CyberSecurity
921   **CIA**   Confidentiality, Integrity, and Availability
922   **COBIT**   Control Objectives for Information and Related Technology
923   **CPS**   Cyber-Physical Systems
924   **DCS**   Distributed Control System
925   **DHS**   Department of Homeland Security
926   **EO**   Executive Order
927   **ICS**   Industrial Control Systems
928   **IEC**   International Electrotechnical Commission
929   **IR**   Interagency Report
930   **ISA**   International Society of Automation
931   **ISAC**   Information Sharing and Analysis Center
932   **ISO**   International Organization for Standardization
933   **IT**   Information Technology
934   **NIST**   National Institute of Standards and Technology
935   **OT**   Operational Technology
936   **PII**   Personally Identifiable Information
937   **RFI**   Request for Information
938   **RMP**   Risk Management Process
939   **SCADA**   Supervisory Control and Data Acquisition
940   **SCRM**   Supply Chain Risk Management
941   **SP**   Special Publication

942 # Appendix D: Errata

943 Changes to Framework version 1.0 incorporated into NIST Cybersecurity Framework Version
944 1.1 are displayed in Table 4.
945
946 **Table 4: Changes in Framework Version 1.1**

PAGE(S)	CHANGE
N/A	Framework version and release date were updated on the title page and in the header/footer
N/A	Table of Contents was modified to reflect the all changes relative to this update
p. 6	Section 1.3 'Document Overview' was modified to reflect the additional section and appendix added with this update
p. 7	Figure 1: 'Framework Core Structure' was added
p. 9	Section 2.2 'Framework Implementation Tiers' - Paragraph 2 was modified to read: "The Tier selection process considers an organization's current risk management practices, threat environment, legal and regulatory requirements, information sharing practices, business/mission objectives, cyber supply chain risk management needs, and organizational constraints. Organizations should determine… "
p. 9	Section 2.2 'Framework Implementation Tiers' - Paragraph 3 was modified to include: "However, Tier selection and designation naturally affect Framework Profiles. The risk disposition expressed in a desired Tier should influence prioritization within a Target Profile. Similarly, the organizational state represented in an assessed Tier will indicate the likely findings of an assessed Profile, as well as inform realistic progress in addressing Profile gaps."
pp. 10-12	Section 2.2 'Framework Implementation Tiers' - An additional property (SCRM) was added to each of the Implementation Tiers
p. 10	Section 2.2 'Framework Implementation Tiers' - Tier 2 'Risk Informed' - Paragraph 2 was modified to include: "Consideration of cybersecurity in mission/business objectives may occur at some levels of the organization, but not at all levels. Cyber risk assessment of organizational assets is not typically repeatable or reoccurring."
p. 11	Section 2.2 'Framework Implementation Tiers' - Tier 3 'Repeatable' - Paragraph 2 was modified to include: "The organization consistently and accurately monitors cybersecurity risk of organizational assets. Senior cybersecurity and non-cybersecurity executives communicate

PAGE(S)	CHANGE
	regularly regarding cybersecurity risk. Senior Executives ensure consideration of cybersecurity through all lines of operation in the organization."
p. 11	Section 2.2 'Framework Implementation Tiers' - Tier 4 'Adaptive' - Paragraph 2 was modified to include: "The relationship between cybersecurity risk and mission/business objectives is clearly understood and considered when making decisions. Senior Executives monitor cybersecurity risk in the same context as financial risk and other organizational risks. The organizational budget is based on understanding of current and predicted risk environment and future risk appetites. Business units implement executive vision and analyze system level risks in the context of the organizational risk appetite and tolerances."
p. 12	Section 2.2 'Framework Implementation Tiers' - Tier 4 'Adaptive' - Paragraph 2 was modified to include: "Cybersecurity risk is clearly articulated and understood across all strata of the enterprise. The organization can quickly and efficiently account for changes to business/mission objectives and threat and technology landscapes in the risk disposition and approach."
p. 13	Figure 2: 'Notional Information and Decision Flows within an Organization' was modified to include additional 'Actions'
p. 14	Section 3.0 'How to Use the Framework' was modified to include the following: "The Framework can be applied in design, build/buy, deploy, operate, and decommission system lifecycle phases. The design phase must account for cybersecurity requirements as a part of a larger multi-disciplinary systems engineering process. A key milestone of the design phase is validation that the system cybersecurity specifications match the needs and risk disposition of the organization as summarized in a Framework Profile. The cybersecurity outcomes prioritized in a Profile must be enacted during either a) development of the system during the build phase or b) purchase or outsourcing of the system during the buy phase. In the system deploy phase, the cybersecurity features of the system should be assessed to verify the design was enacted. The cybersecurity outcomes of Framework then serve as a basis for on-going operation of the system, including occasional re-assessment to verify cybersecurity requirements are still fulfilled. Owed to an inevitable Web of dependencies amongst systems, Framework outcomes must be carefully considered as one or more systems are decommissioned."
p. 15	Section 3.2 'Establishing or Improving a Cybersecurity Program' - Step 1: 'Prioritize and Scope' was modified to include: "Implementation Tiers may be used to express varying risk tolerances."
p. 15	Section 3.2 'Establishing or Improving a Cybersecurity Program' - Step 2: 'Orient' was modified to now read as follows: "Once the scope of the cybersecurity program has been determined for the business line or process, the organization identifies related systems and assets, regulatory requirements, and overall risk approach. The organization then consults sources to identify threats and vulnerabilities applicable to those systems and assets."

PAGE(S)	CHANGE
p. 15	Section 3.2 'Establishing or Improving a Cybersecurity Program' - Step 3: 'Create a Current Profile' was modified to include: "If an outcome is partially achieved, noting this fact will help support subsequent steps."
p. 15	Section 3.2 'Establishing or Improving a Cybersecurity Program' - Step 4: 'Conduct a Risk Assessment' was modified to now read as follows: "This assessment could be guided by the organization's overall risk management process or previous risk assessment activities. The organization analyzes the operational environment in order to discern the likelihood of a cybersecurity event and the impact that the event could have on the organization. It is important that organizations identify emerging risks and use cyber threat information from both internal and external sources to gain a better understanding of the likelihood and impact of cybersecurity events."
pp. 15-16	Section 3.2 'Establishing or Improving a Cybersecurity Program' - Step 5: 'Create a Target Profile' was modified to include: "When used in conjunction with an Implementation Tier, characteristics of the Tier level should be reflected in the desired cybersecurity outcomes."
p. 16	Section 3.2 'Establishing or Improving a Cybersecurity Program' - Step 6: 'Determine, Analyze, and Prioritize Gaps' was modified to now read as follows: "The organization compares the Current Profile and the Target Profile to determine gaps. Next, it creates a prioritized action plan to address those gaps drawing upon mission drivers, a cost/benefit analysis, and risk understanding to achieve the outcomes in the Target Profile. The organization then determines resources necessary to address the gaps. Using Profiles in this manner enables the organization to make informed decisions about cybersecurity activities, supports risk management, and enables the organization to perform cost-effective, targeted improvements."
pp. 16-18	Section 3.3 'Communicating Cybersecurity Requirement with Stakeholders' was modified to include Supply Chain Risk Management.
p. 17	Figure 3: 'Cyber Supply Chain Relationships' was added
p. 18	Section 3.4 'Buying Decisions' was added
p. 18	Section 3.5 'Identifying Opportunities for New or Revised Informative References' (previously Section 3.4) was moved to accommodate an additional section.
p. 18	Section 3.6 'Methodology to Protect Privacy and Civil Liberties' (previously Section 3.5) was moved to accommodate an additional section.

PAGE(S)	CHANGE
p. 19	Section 3.6 'Methodology to Protect Privacy and Civil Liberties' - a portion of this section was modified to now read as follows: "Privacy and cybersecurity have a strong nexus. It is well-recognized that cybersecurity plays an important role in protecting individuals' privacy; for example, with respect to the confidentiality of assets containing personal information. Nonetheless, an organization's cybersecurity activities also can create risks to privacy and civil liberties when personal information is used, collected, processed, maintained, or disclosed in connection with an organization's cybersecurity activities. Some examples of activities that bear privacy or civil liberties considerations may include: cybersecurity activities that result in the over-collection or over-retention of personal information; disclosure or use of personal information unrelated to cybersecurity activities; cybersecurity mitigation activities that result in denial of service or other similar potentially adverse impacts, including activities such as some types of incident detection or monitoring that may impact freedom of expression or association."
p. 20	Section 3.7 'Federal Alignment' was added
p. 21	Section 4.0 'Measuring and Demonstrating Cybersecurity' was added
pp. 21-22	Section 4.1 'Correlation to Business Results' was added
pp. 23-24	Section 4.2 'Types of Cybersecurity Measurement' was added
p. 23	Table 1: 'Types of Framework Measurement' was added
p. 26	Table 2: 'Function and Category Unique Identifiers' (previously Table 1) was moved to accommodate an additional table.
p. 26	Table 2: 'Function and Category Unique Identifiers' was updated to include an additional Category (ID.SC) Supply Chain Risk Management
p. 27	Table 3: 'Framework Core' (previously Table 2) was moved to accommodate an additional table.
p. 27	Appendix A: 'Framework Core' - Subcategory ID.AM-5 was modified to now read as follows: "Resources (e.g., hardware, devices, data, time, and software) are prioritized based on their classification, criticality, and business value"

PAGE(S)	CHANGE
p. 28	Appendix A: 'Framework Core' - Subcategory ID.BE-5 was modified to now read as follows: "Resilience requirements to support delivery of critical services are established for all operating states (e.g. under duress/attack, during recovery, normal operations)"
p. 28	Appendix A: 'Framework Core' - Subcategory ID.GV-1 - Informative Reference was added 'CSC(V6) 19.2'
p. 29	Appendix A: 'Framework Core' - Subcategory ID.RA-2 was modified to now read as follows: "Cyber threat intelligence and vulnerability information is received from information sharing forums and sources"
p. 30	Appendix A: 'Framework Core' - Subcategory ID.RA-6 - Informative Reference was added 'CSC(V6) 4.8'
pp. 30-32	Appendix A: 'Framework Core' - Category ID.SC: 'Supply Chain Risk Management' and subsequent Subcategories (ID.SC-1, ID.SC-2, ID.SC-3, ID.SC-4, ID.SC-5) and Informative References were added
p. 32	Appendix A: 'Framework Core' - Category PR.AC: 'Access Control' was retitled to "Identity Management, Authentication and Access Control" and now reads: "Access to physical and logical assets and associated facilities is limited to authorized users, processes, or and devices, and is managed consistent with the assessed risk of unauthorized access to authorized activities and transactions."
p. 32	Appendix A: 'Framework Core' - Subcategory PR.AC-1 was modified to now read as follows: "Identities and credentials are issued, managed, verified, revoked, and audited for authorized devices, and users, and processes"
p. 32	Appendix A: 'Framework Core' - Subcategory PR.AC-4 was modified to now read as follows: "Access permissions and authorizations are managed, incorporating the principles of least privilege and separation of duties"
p. 33	Appendix A: 'Framework Core' - Subcategory PR.AC-6 and subsequent Informative References were added
p. 35	Appendix A: 'Framework Core' - Subcategory PR.DS-8 and subsequent Informative References were added
p. 35	Appendix A: 'Framework Core' - Subcategory PR.IP-1 was modified to now read as follows: "A baseline configuration of information technology/industrial control systems is created

PAGE(S)	CHANGE
	and maintained incorporating appropriate security principles (e.g. concept of least functionality)"
p. 38	Appendix A: 'Framework Core' - Subcategory PR.PT-3 was modified to now read as follows: "The principle of least functionality is incorporated by configuring systems to provide only essential capabilities"
p. 39	Appendix A: 'Framework Core' - Subcategory PR.PT-5 and subsequent Informative References were added
p. 45	Updated reference, 'Council on CyberSecurity (CCS)' to 'Center of Internet Security (CIS)' and updated link to 'https://www.cisecurity.org'
p. 47	Appendix B: 'Glossary' - was modified to include the term 'Buyer' with the definition: "The people or organizations that consume a given product of service"
p. 48	Appendix B: 'Glossary' - was modified to include the term 'Lagging Measurement' with the definition: "A measurement of whether an outcome was fulfilled or not"
p. 48	Appendix B: 'Glossary' - was modified to include the term 'Leading Measurement' with the definition: "A predictive measurement that may guide future activities to achieve a specific outcome"
p. 48	Appendix B: 'Glossary' - was modified to include the term 'Measures' with the definition: "Quantifiable, observable, objective data supporting Metrics. Typically, Measures align with technical controls, such as the Informative References."
p. 48	Appendix B: 'Glossary' - was modified to include the term 'Metrics' with the definition: "Used to facilitate decision making and improve performance and accountability. Typically, Metrics are higher level, qualitative, and an aggregate of several Measures."
p. 48	Appendix B: 'Glossary' - was modified to include the term 'Non-IT/OT Partner' with the definition: "Product or service providers that do not provide IT or OT to a given organization, but who do affect the security of that organization."
p. 49	Appendix B: 'Glossary' - was modified to include the term 'Supplier' with the definition: "Product and service providers used for an organization's internal purposes (e.g., IT infrastructure) or integrated into the products of services provided to that organization's Buyers."

PAGE(S)	CHANGE
p. 50	Appendix C: 'Acronyms' - was modified to include CPS - Cyber-Physical Systems
p. 50	Appendix C: 'Acronyms' - was modified to include OT - Operational Technology
p. 50	Appendix C: 'Acronyms' - was modified to include PII - Personally Identifiable Information
p. 50	Appendix C: 'Acronyms' - was modified to include SCRM - Supply Chain Risk Management

947